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## THE SINKING OF LARGE STONES THROUGH THE ACTION OF WORMS.

By CHARLES DAVISON, SC.D., F.G.S.

TWENTY years have passed since Mr. Darwin published his last work.* If in his "Descent of Man," as one reviewer remarked, he had put down the mighty from their seat, in his "Vegetable Mould" he exalted them that are of low degree, and few of his many observations are more interesting than those which relate to the habits and rude intelligence of earth-worms. Equally valuable and no less surprising were his measurements of the amount of soil brought to the surface by worms and of the rate at which layers of stones were covered by their castings. In different places, the castings were collected regularly over measured areas and were found to yield a layer of soil which, if spread over the same areas, would in ten years vary from about one to one-and-a-half inches in thickness. The depth of mould which accumulated over small stones strewn on the surface of fields was found, after intervals of seven to nearly thirty years, to range from 1.9 to 2.2 inches in ten years.

"When a stone of large size and of irregular shape," says Mr. Darwin, "is left on the surface of the ground, it rests, of course, on the more protuberant parts; but worms soon fill up with their castings all the hollow spaces on the lower side; for, as Hensen remarks, they like the shelter of stones. As soon as the hollows are filled up, the worms eject the earth which they have swallowed beyond the circumference of the stones; and thus the surface of the ground is raised all round the stone. As the burrows excavated directly beneath the stone after a time collapse, the stone sinks a little. . . . If, however, a boulder is of such huge dimensions, that the earth beneath is kept dry, such earth will not be inhabited by worms, and the boulder will not sink into the ground."

Mr. Darwin gives several examples of this gradual sinking of large stones. It will be sufficient for our present purpose to quote one. A block of quartzose sandstone, 64 inches long, 17 inches broad, and from 9 to 10 inches in thickness, had been left on a bare surface of broken bricks and mortar. Thirty-five years later, when it was examined by Mr. Darwin, the ground surrounding the stone was covered with turf and mould, which for a distance of about nine inches round the stone gradually sloped up to it, and close to it the surface was about four inches above the surrounding ground. The lower surface of the stone was uneven, and the projections were still found resting on the brick-rubbish, but the intervening spaces were filled up by worm-castings, so that, when the stone was removed, an exact cast of its lower side was left. The whole stone had sunk about 1½ inches in the 35 years, that is, at the rate of .43 inch in ten years.

This estimate, however, must be less than the true amount, for some time would be lost in filling up the vacant space below the stone; and, in order to determine the rate more accurately, an experiment was commenced in the autumn of 1877 by Mr. Darwin's youngest son and continued during an interval of nearly twenty years. The results of this work were communicated to the Royal Society last May in a short paper, of which the present is an abstract.†

The place selected for the purpose was a nearly level field near Mr. Darwin's house at Down, which had probably been pasture for more than fifty years, and under a large Spanish chestnut tree.‡ A circular stone about 18 inches in diameter and 2¼ inches thick, and weighing about 41 lbs. was laid upon the ground. A hole was made through its centre and was lined with a brass cylinder, containing on the top three horizontal projecting pieces leaded into the upper surface of the stone. In each of these pieces, a radial V-shaped groove was cut.

* "The Formation of Vegetable Mould, etc." (Murray, 1881.)

† Horace Darwin: "On the small vertical movements of a stone laid on the surface of the ground." *Roy. Soc. Proc.*, Vol. LXVIII., 1901, pp. 253-261. A preliminary account of the experiment was given by Messrs. G. H. and H. Darwin, in their report on the lunar disturbance of gravity. *Brit. Assoc. Rep*, 1881, pp. 122, 123.

‡ This situation was afterwards seen to be unfavourable. Movements of the stone might be caused by the growth of the roots, and worm-castings are sometimes absent underneath trees.

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To obtain a fixed point, from which the displacements of the stone were to be measured, two rods, one of copper and the other of iron, and each .86 of an inch in diameter, were driven side by side into the ground to a depth of about 8½ feet, and the ends were cut off so that they stood at first about 3 inches above the ground, or not quite an inch above the upper surface of the stone, which was placed with the rods projecting through the central hole.

The measurements were made with the instrument shown in Fig. 1. A is a brass ring, containing three

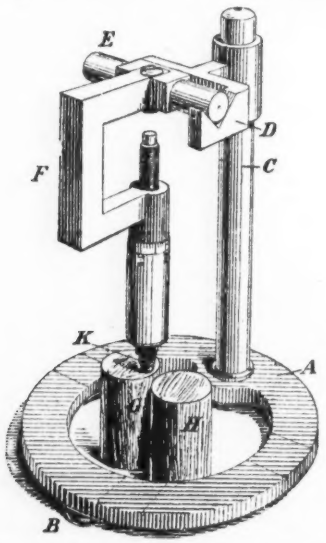


FIG. 1.—Instrument for Measuring the Movement of a Stone
From the *Proceedings of the Royal Society.*

rounded feet, B, which, at the time of reading, were placed in the V-shaped grooves mentioned above. C is a vertical brass rod, to which an arm D, with V-shaped bearings is soldered. An ordinary micrometer screw gauge, F, at the upper end of which trunnions, E, were fixed, is placed with the trunnions resting in the V-shaped bearings, D. At the beginning of each measurement, the lower end, K, of the micrometer screw is vertically above the top of one of the rods, G, H. The screw is then turned until the end, K, just touches the rod, and the reading is taken. By moving the trunnions along the V-shaped bearings, D, the screw is made to touch the top of the other rod, and the reading repeated. The object of the double measurements with rods of different metals was to eliminate the small error arising from the expansion of the rods; but, in this respect, the experiment was unsuccessful, and the measurements given below are only those obtained from the copper rod uncorrected for expansion.

Movements of the stone were produced by other agencies than the burrowing of earth-worms. Some, but an unknown, displacement may have been caused by the growth of the roots of the chestnut-tree, under which the stone lay. But this, if it occurred, must have been far less than that due to frost and changes in the dampness of the ground. The stone, indeed, was found to be in a state of continual vertical oscillation. When the soil was damp from recent rain, one or two cans of water poured on the ground near the stone made it rise $\frac{1}{50}$th of an inch in about seven hours. During a severe frost in the beginning of 1879, the stone rose $\frac{3}{10}$ths of an inch; and, during the thaw which followed a slight frost a little later in the same year, it fell nearly $\frac{1}{10}$th of an inch in less than five hours, even though the ground below was still hard.

The oscillations of the stone due to the varying dampness of the ground from Feb. 19 to Oct. 9, 1880, are represented by the continuous line in Fig. 2, the scale

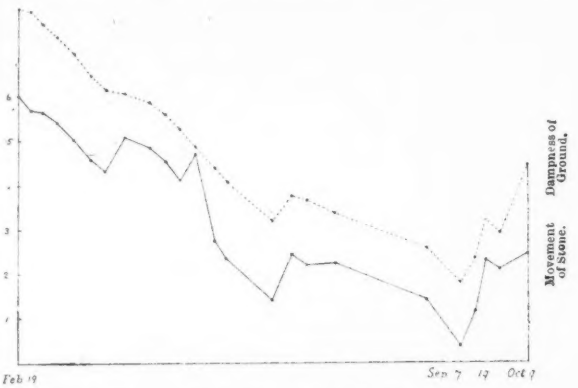


FIG. 2.—Diagram showing the Oscillations of the Stone.

being magnified so that each of the divisions on the left-hand side of the diagram represents $\frac{1}{25}$ths of an inch. The dotted line in the same figure indicates roughly the dampness of the soil, the ordinates being proportional to the amount of rainfall diminished by that which ran off or evaporated.§ With two exceptions, the cause of which is unknown, it will be seen that the curves follow one another very closely, especially during the latter part of the time. Between Sept. 7 and 19, there was heavy rain, and in the interval the stone rose $\frac{3}{40}$ths of an inch. At the beginning of 1881, there was a severe frost, and, owing to this and the previous wet season, the stone stood $\frac{1}{6}$th of an inch higher on Jan. 23 than on Sept. 7 of the previous year.

Until the end of 1886, the position of the stone was usually measured each winter and summer, and during the next ten years in the summer only. The curve obtained from the summer measurements is more irregular than from those made in winter, probably on account of the greater variation in the dampness of the soil in summer. During the last nine years in which the experiment was made (1887-1896), the total descent, given by summer measurements, was less than $\frac{1}{8}$th of an inch. It is difficult to account completely for this very slow rate, but, during part of the time, the rainfall was certainly above the average. In the earlier half of the interval, however, the rate of descent was much greater; though this may have been partly due to the decaying of the grass, for the stone was at first placed directly on the turf. Taking the winter readings, Mr. Horace Darwin found that the stone sank $\frac{7}{10}$ths of an inch in the eight years from 1878 to 1886, or at the rate of $\frac{7}{8}$ths of an inch in ten years. This, as we might expect, is much less than the rate at which worms cover up small pebbles, but it is about twice as great as that at which the large stone examined by his father sank into the ground.

§ The rainfall was measured at Leaves Green, a place about one mile from Down, and nearly on the same level. In estimating the deduction for evaporation, the soil was supposed to dry at a uniform rate.

# THE WHITE NILE—FROM KHARTOUM TO KAWA.

## AN ORNITHOLOGIST'S EXPERIENCES IN THE SOUDAN.

By HARRY F. WITHERBY, F.Z.S., M.B.O.U.

### V.—BIRDS.

ONE of the finest sights in bird-life is that of a falcon taking its prey. Lanner falcons* were fairly common on the White Nile, and several times they swooped down upon sandgrouse which we had winged, and attempted to carry them off. Usually, however, a shout would make the falcon drop such easily won prey. One day when we were riding, a bird rushed over our heads at a terrific pace flying towards the river, which was not more than a hundred yards away. Before we could determine the species of the bird there was another rush of wings over our heads, and looking up we saw two lanner falcons flying side by side. They did not appear to be going very fast, but their pace must have been great, since in the short distance between us and the river, they made up the thirty yards or so between them and the bird they were chasing. Just as they caught it up, one of them shot forward slightly and made a downward swoop like a flash. It then sailed on along the river's edge, while the other immediately turned and flew leisurely back the way it had come. There had been no struggle and no uneven movements on the part of the falcon and nothing to indicate that the prey was taken. We could only imagine that the pursuers were disappointed and that they did not care to continue the chase across the river which the quarry seemed to have reached, but as it had unaccountably disappeared from our sight we could not be sure. The falcon which had made the swoop and was flying along the river's edge settled upon the ground some 200 or 300 yards away from us, and then to our intense surprise, we saw that it had indeed captured its prey in that rapid swoop, and that it was now standing upon it and tearing it. We shouted and fired a shot and the falcon rose, but bore off its prize and would not release it, so that we could only conjecture from the brief sight that we had of it as it was rushing over our heads, that it was a pigeon or a sandgrouse.

Sandgrouse shooting at many points along the banks of the White Nile affords such sport that millionaires would give untold gold for were it to be had in England or Scotland. For an hour or more between 7 and 9 in the morning one can stand behind a bush or sand-hill with a continuous stream of birds passing like rockets backwards and forwards over one's head. Flock after flock comes down from the dry dusty desert to the cool waters of the river. The birds generally stay at the river for but a few moments. Alighting on the edge of the water or often with their feet submerged, they take a sip or two, and then flying up and whirling round, shoot back to their desert home. In some places, however, where broad grassy flats bordered the river, a large number of sandgrouse were to be found all day, and they seemed to live and feed there in preference to the arid inland country. There were two species of these sandgrouse. The majority were of a species† with a sandy-coloured back and a rich dark breast, a bird which is found in astonishing numbers over the greater part of the northern half of Africa. The other species‡ was decidedly rare and only seen singly or in pairs and never in flocks. It was a larger bird of a less uniform colouring, and with bright yellow throat and cheeks.

Although these birds gave such good sport and were, besides, a very welcome addition to the wiry fowls and an occasional, and always aged, sheep or goat which we obtained from the natives, the shooting of them was by no means a pleasure. The great dry heat of the Soudanese summer injured almost everything we possessed, and the effect it had upon the white powder with which our cartridges were loaded produced most trying results. I was told by an expert at home that the extreme dryness of the atmosphere withdraws the moisture from the powder and so causes a too rapid explosion. The fulminate in the cap of the cartridge is affected in the same way, and, as a consequence, all the powder is probably ignited at once, a great deal of gas is generated, and a considerable explosion occurs. The result is extremely uncomfortable and annoying. After shooting 10 or 12 cartridges one becomes quite deaf, and the recoil of the gun makes a considerable bruise. Moreover, a strong heavy gun after a time was so damaged as to become dangerous to use. We found that the explosion was much more violent after the cartridges had been carried in the sun for some hours, and also after several shots had been fired in quick succession. Metal and glass exposed to the sun were always burning hot, and after a few shots had been fired quickly a gun was too hot to hold with the bare hand. I am advised on good authority that this violent explosion of white powder in a hot dry climate could be prevented by using a small cap and a small charge of powder. A charge of 35 grains of Schulze to one oz. of shot in a twelve-bore cartridge instead of the usual charge of 38 grains of powder would remedy the defect without deteriorating the killing power. But care must be exercised in the loading, and the extra space in the cartridge case must not be filled with hard wads or used for a deep "turn-over," which would tend to keep the powder back and increase the recoil.

Besides the sandgrouse, pigeons§ provided us with many a meal—indeed, too many. So numerous were these pigeons and so thickly did they cluster in the trees that, to save time and ammunition, we often shot from twelve to sixteen with a single cartridge. The pigeons were great drinkers, but unlike the sandgrouse, their favourite hour for imbibing was just before sunset. Sandgrouse also came down to the river just then, but only irregularly and in small numbers. Apparently only the very thirsty individuals drank in the evening as well as the morning. After their drink the pigeons flew to a considerable height in the air and then, arriving above their intended roosting place, they suddenly closed their wings and hurled themselves down like stones. Just before the tree-tops were reached they checked their headlong plunge with outstretched wings, and circling round once or twice, alighted noisily in the acacias. In fact this downward plunge to the roosting trees was performed by these African pigeons in much the same way as it is by our wood pigeons at home.

One evening, from the same spot, I fired some twenty shots at pigeons as they were plunging down, and I noticed in a tree thirty yards away from me a little bittern,‖ which sat motionless stretched upwards as stiff as a ramrod during the whole cannonade. We saw many little bitterns in the trees in the Soudan, and they generally adopted this stiff and attenuated attitude.

* *Falco tanypterus*, Schl. † *Pteroclurus exustus* (Temm.).
‡ *Pteroclurus senegallus* (Linn.).

§ *Turtur ambiguus* Boc. *Turtur roseogriseus* (Sundev.).
‖ *Ardetta minuta* (Linn.).

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which is undoubtedly assumed for purposes of concealment. I have seen the bird in the same attitude amongst green reeds in Spain, but there, as in the acacias in the Soudan, the bird benefited nothing by this strange posture. The little bittern is a cream-coloured bird with a velvety black back and head, and I think it could never be taken for a stick or reed except perhaps in broken light. With the brown-coloured common bittern, which adopts the same pose, the case would be different. One might suppose, however, that the little bittern itself considered the attitude a complete protection by adopting it on the approach of danger, and by remaining motionless through such a terrifying ordeal as the sound of the twenty shots I have mentioned. Had the bird frequented the thicker trees, its stick-like attitude might have saved it from detection, but in the open trees in which we generally found it the trick was a ludicrous failure.

There were other birds in this country which either by their protective colouring or by their attitudes were rendered inconspicuous and often invisible. Those which relied upon their colour for concealment were, as would be expected, birds of the open country, and their colouring was, of course, like the sand. Of those I have mentioned—various species of larks were difficult to see even when they were flying, the fantail warbler was exactly the colour of sand or dead grass; the sandgrouse was impossible to distinguish at a short distance in the desert, as were the cream-coloured coursers on the sand by the river. The birds living amongst the trees depended upon the thickness of the branches and twigs for concealment, and although there were few trees with leaves, it was extraordinary how perfect a protection they were afforded. Even the most brightly coloured birds were hidden in a thick mimosa bush or acacia tree, and most of the shy birds seemed to recognise this fact, and rather than fly away would retire into the thickest part of a tree. Mouse birds or colies,¶ for instance, flew into a tree and disappeared as if by magic. They have a sweet piping note, and often on hearing this sound I used to creep under the tree from which it came and watch these long-tailed parakeet-like birds creeping and climbing as mice in and out amongst the thickly-growing twigs and branches in the centre of the tree. On catching sight of me looking up at them they would give a hurried, rather gasping, pipe, and climb with wonderful dexterity and swiftness towards the outside of the tree furthest away from danger. When all had arrived on the edge they would fly away, softly piping.

Birds of the night are perhaps the cleverest at hiding themselves. Once when strolling round a mid-day camp to escape the groaning of the camels as they were being loaded, I saw what appeared to be a broken piece of bough in a very thick tree. I was struck by its rather bird-like shape, but should have passed it had I not the habit of looking with my binoculars at puzzling sights. The binoculars made the stump look still more bird-like, and after walking all round the tree I at last made out two horns, which I knew must come from the head of an owl. I ran to the camp for a gun and fetched my companions, who assured me the thing was only a stump. I fired at it and down fell two owls, while a third flew away. So that the "stump" was in fact three birds huddled up together. They were beautiful little horned owls of a rare species.**

The only other owls we found were a large handsome eagle owl,†† and a white or barn owl.‡‡ The latter was rather more spotted on the breast than our familiar English bird, and for this reason Brehm, who collected birds in the Khartoum district many years ago, gave the barn owl of these parts the sub-specific name of *maculata*. It is remarkable that although the barn owls are spread over most of the world, they preserve so constant a type that, unlike the generality of birds in similar case, they cannot be separated into different species, although their slight variations enable the diligent systematist to divide them into races or sub-species. The fact that the barn owl seldom migrates, and is a more or less sedentary bird, makes its want of variation all the more remarkable. The only bird of this species that we found inhabited the rocky hill, Gebel Auli, which I have already mentioned as the haunt of bats and hedgehogs. The owl seemed to have no mate and lived in a small cavern in the rock. This had perhaps been used as a nesting place, and it was littered with castings of the rejected fur and bones of the bird's prey.

It was after climbing about this hill and searching its crevices from top to bottom that Mahomet, my stately gunbearer, said he felt very ill and must have a doctor. We considered that he was malingering, but when he told us that he was always accustomed to be bled once a month and had not now had any blood drawn for two whole months, we bowed to his decision and waited eagerly for the doctor. The real doctor of the village of some twenty huts at Gebel Auli was away

Fig. 1.—Bleeding Mahomet. The doctor adjusting the "cup."

on a journey, but his *locum tenens*, who was a decidedly inferior practitioner we were told, put in an appearance. After a long harangue Mahomet decided to be operated on by him. The doctor came unprovided with a lancet, but he soon borrowed a razor from Salim, one of the camel men. His only other instrument was a piece of a cow's horn with the narrow end closed by a bit of tin. Mahomet resignedly lay down in the shade, and the operation, the various stages of which we somewhat callously photographed, commenced. The patient's head was shaved and then the cow's horn was placed on the side of the neck. The doctor applied his lips to this primitive "cup" and sucked vigorously until a vacuum was formed, when he closed the opening with the piece of tin. In a few minutes the horn was taken off and revealed a large bump raised on the neck. A

¶ *Colius macrurus* (Linn.). ** *Scops leucotis* (Temm.).

†† *Bubo lacteus* (Temm.). ‡‡ *Strix flammea* (Linn.).

few cuts were made with the borrowed razor and then the horn was put on again and the blood drawn out by the vacuum. By repeating this process seven times on

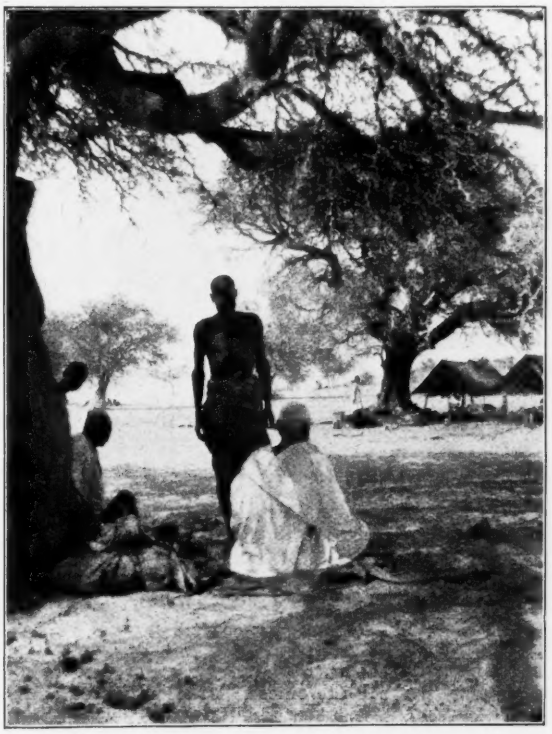


Fig. 2.—The "cup" fixed on the neck.

each side of the neck the doctor drew some 5 ozs. of blood from Mahomet. The moderate fee of one piastre (2½d.) was charged, but we were told with some pride that the proper doctor would have charged two piastres. We had always considered Mahomet wanting in blood, but on the morning after the operation he said that he was now perfectly well and we cheerfully believed in the efficacy of the leech.

We rather thought that so primitive a doctor should have a primitive fee, such as an old bottle or tin, or even a bit of cloth, for his own was of the scantiest. But the natives as far as we travelled would take nothing but money. We had provided ourselves with knives, razors and the like for barter, but these would never be accepted as payment although they were demanded, but not given, as baksheesh. Hassan's explanation of the use to which the money was put, ran as follows:—"Dey do put it in hole in ground and ebery six months or year dee faber ob dem do go to next big billage and buy in bazaar all tings for ladies and him and—eberyting."

## THE INSECTS OF THE SEA.—VI.

By Geo. H. Carpenter, B.Sc.(Lond.), *Assistant in the Museum of Science and Art, Dublin.*

### FOUR-WINGED FLIES.

The various orders of insects that may be roughly designated "four-winged flies" have very few marine representatives. Every student of "pond-life" knows the hairy-winged Caddis-flies (Trichoptera) whose grubs —the Caddis-worms—live in fresh-water and build up for themselves little "houses" of stones, sticks, leaves, and even snail-shells. Several caddis-worms inhabit brackish-water, and at least one, belonging to the New Zealand species, *Philanisus plebeius*, Walker, dwells in the sea between tide-marks. It was found by Capt. Hutton in Lyttleton Harbour in a straight tubular case made of fragments of coralline seaweeds, and tiny stones.* The great order of the moths and butterflies (Lepidoptera) is represented at sea only by stray specimens flitting along the shore or by migrating swarms of strong-flying species crossing channels or oceans. But the Hymenoptera (comprising the saw-flies, gall-flies, ants, wasps and bees) seem to have some truly marine members. Prof. Moniez discovered† near Aigues-Mortes on the French Mediterranean coast, crowds of minute black parasitic flies (belonging to the family Proctotrupidæ), sheltering under stones between tide-marks. These had well-developed wings, which they may perhaps use as propellers when swimming through the water.

### BUGS.

Our survey of the Insects of the Sea must conclude with the bugs—the order Hemiptera (or Rhynchota) of zoologists. These are far from being the most highly organised of insects, and their marine representatives are comparatively few. Yet among them are found not only haunters of the tidal margin and the rock-pools, but also daring adventurers trusting themselves boldly to the waters of the ocean, over whose surface they walk, often hundreds of miles from land. This order of insects shows, therefore, the most perfect adaptation to marine life.

The characteristic structural feature of Bugs is to be found in their jaws, which are formed for piercing and sucking. The mandibles and first pair of maxillæ are transformed into piercing stylets, which work to and fro in a grooved beak made up by the fusion of the maxillæ of the second pair. This beak usually rests beneath the insect's breast with the point directed backwards. Unlike the higher insects—such as Beetles, Moths, Flies and Bees—the Bugs undergo no marked transformations. The young, except for the absence of wings, are hatched in a form much like that of their parents, and attain the adult condition by slow degrees, the wing-rudiments—visible outside the body—gradually increasing in size after each moult. In the marine Bugs, however, wings are never developed at all.

Like other orders of insects, the Bugs show a gradual transition in some groups from a terrestrial to a marine habit of life. The dull, oval, convex insects forming the genus Salda, for example, have some species frequenting dry heaths, others haunting the edges of ponds and streams, and yet others dwelling close to tidal waters or on salt-marshes; these latter are well able to endure submersion, and at high tide they sometimes crawl slowly about under water.

But most of the truly marine Bugs belong to markedly distinct and isolated genera. The only example of the Order found on the sea-coasts of our islands, though related to the Saldidæ, is now placed in a family all by itself—a family comprising but a single species.

* R. McLachlan, "On a Marine Caddis-fly from New Zealand," *Journ. Linn. Soc.* (Zool.), Vol. XVI., 1883, pp. 417-422.

† R. Moniez. "Sur un Hymenoptère Halophile." *Rev. Biol. N. France*, Vol. VI., 1894, pp. 439-441.

*Aepophilus Bonnairei*‡, as this insect was called some twenty years ago by its describer, M. Signoret, is a flattened, elongate oval bug about $\frac{1}{5}$ inch long, with the hind-wings apparently absent and the fore-wings reduced to very small vestiges (Fig. 1). The name Aepophilus was bestowed upon the insect because of its discovery in company with beetles of the genus Aepus, described in a previous article of this series. It has never been found except between tide-marks, and almost always seems to shelter under stones, though it has been noticed also beneath a stranded star-fish. On the coast of Sark, M. Koehler found specimens beneath large stones in a cave into which the tide only permits entrance four times a year. Mr. Keys, who has observed the insects on the south-west coast of England, found them to occur in greatest numbers beneath large boulders in a channel far out beyond a reef of rocks—a situation covered by the sea for twenty hours out of the twenty-four. Here "in a space that could have been covered by a crown piece, there was a group of the undeveloped forms with a single mature specimen in their midst, just as one often finds a family of earwigs, or sees a hen surrounded by her chickens." The life of these strange insects beneath great boulders at the sea-bottom is full of mystery. Apparently they can neither survive immersion in sea-water, nor walk on the surface; "they hide in companies in little holes in the stone, packed together as closely as possible, or rest on the algaic growth thereon." Probably these humble seaweeds furnish them with food, though it has been suggested that they eat decaying animal matter. Aepophilus is a very scarce insect, and seems confined to the western European and Britannic coasts. It has been observed in Spain; on the Ile de Ré, off the west coast of France; Jersey and Sark in the Channel Islands; Dorset, Devon and Cornwall in south-western England; and Waterford in southern Ireland. Such a distribution, together with its isolated systematic position and retiring habits, shows that it must be an ancient type of bug, driven to extremities in order to maintain any standing at all in the teeming insect-world of to-day.

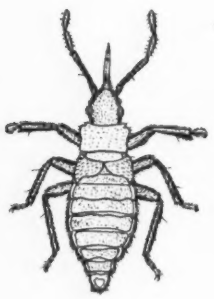


FIG. 1.

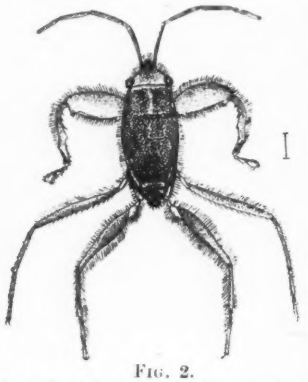


FIG. 2.

FIG. 1.—*Aepophilus Bonnairei* (male), with beak extended, Jersey. Magnified 9 times

FIG. 2.—*Hermatobates Haddonii* (male), Torres Straits. Magnified 6 times.

‡ V. Signoret. "Le Genre Aepophilus." *Tijdschr. Ent.*, Vol. XXIII., 1880, pp. 1-3, pl. 1.—R. Koehler. "La Faune littorale des Iles Anglo-Normandes." *Ann. Sci. Nat.* (Zool.), Vol. XX., 1885, pp. 27-9.—J. H. Keys. "Aepophilus Bonnairei." *Ent. Mo. Mag.*, Vol. XXIV., 1888, p. 174; (2), Vol. I., 1890, p. 247; (2) Vol. VI., 1895, pp. 135-7.—E. Bergroth. "Notes on the genus Aepophilus." *Ent. Mo Mag* (2) Vol. X., 1899, pp. 282-3.

Far away on tropical coral-reefs lives another peculiar genus of marine bug. Hermatobates, as this insect is called, is as small as Aepophilus, and far more remarkable in structure. The three segments of the thorax are fused together, wings are entirely wanting, and the abdomen has undergone such extreme reduction that the slender middle and hind legs look to be inserted at the far tail-end of the body. The fore-legs are very broad, strong and spiny, evidently adapted for clinging, and perhaps for seizing prey (Fig. 2). Of the life of these curious insects hardly anything is known. The typical species, discovered on a reef off the island of Mabuiag in Torres Straits by Prof. Haddon in 1889, and named after him by the present writer,§ was subsequently met with on Guichen Reef, near Troughton Island in the Arafura Sea by Mr. J. J. Walker. "They occurred," he writes, "under large dead bivalve shells (Tridacna), and with them I found a good-sized spider which must have been submerged on this completely isolated reef twice every day to a depth of ten or more feet." It is curious that Prof. Haddon's specimen also occurred in company with a spider—*Desis Martensii* by name—well-known from various maritime stations in the eastern tropics. It is likely that further research will show some beneficial association between this large spider—who retires at high water into holes in the coral-rock protected by a sheet of web—and her tiny companion.

Only during the present year has a second species of Hermatobates been discovered, MM. H. Coutière and J. Martin having described one from the coast of Somaliland, in East Africa. These little bugs have evidently therefore a wide distribution in the tropics. The same naturalists also record the occurrence on Honda Bay in the Philippines of an allied insect, which they refer to a distinct genus Hermatobatodes. Only females of the latter have been found, while of Hermatobates only males are yet known. These, like many other Bugs of the "sterner sex," seem able to produce musical sounds to charm their mates, for a comb-like row of spines on the face of the flattened fore-shin can hardly be regarded otherwise than as a stridulating organ.

The East African species, *H. djiboutensis*, was not found crawling on the coral rock, but skimming over the surface of a pool, and the Philippine insect occurred on the waters of the bay. These marine Bugs, therefore, sometimes at least, adopt the habit of the well-known pond-skaters, Gerridæ, in which family they must probably be included, though they certainly form a very aberrant sub-family thereof. Among the Gerridæ adaptation for walking on the surface-film of water reaches its highest point.

One of the best known European fresh-water members of this family is the dark brown *Velia currens*, which may often be seen darting about over the surface of running streams. In most tropical countries species of the allied Rhagovelia are to be found. These insects have a wonderful and beautiful organ for assisting their walk over the surface-film, in a system of branching ciliated hairs set in the deep cleft of the terminal segment of the feet of the middle pair of legs (Figs. 4, 5). This set of hairs can be retracted and hidden within the cleft of the foot, or spread out like the spokes of a wheel so as to form a disc-like area of support. Two

§ G. H. Carpenter. "Rhynchota from Murray Island and Mabuiag." *Sci. Proc. R. Dublin Soc.*, Vol. VII., 1892, pp. 137-146, pls. XII., XIII.—H. Coutière and J. Martin. "Sur une nouvelle sous famille d'Hémiptères marins, les Hermatobatinæ," *Comptes Rendus Acad. Sci.*, Vol. CXXXII., 1901, pp. 1066-8.

or three marine species closely allied to Rhagovelia, have been discovered on the surface of tropical American seas—in all cases close to land, and in consequence of the remarkable development of this "wheel-foot" have

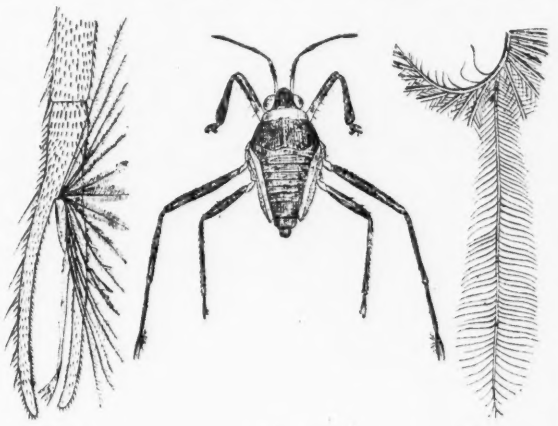


FIG. 4. FIG. 3. FIG. 5.

FIG. 3.—*Trochopus plumbeus* (female), Jamaica. Magnified 9 times.
FIG. 4.—Terminal Segment of second foot. Magnified 75 times.
FIG. 5.—Arrangement of ciliated hairs. Magnified 150 times.

received the name of Trochopus.‖ These bugs (Fig. 3) are covered with a dense velvety pile which prevents them from being wetted. Occasionally at least they dive beneath the surface of the water, when they carry an air-bubble down with them. Another marine wingless relation of Velia was discovered on Cartier Island in the Timor Sea by Mr. J. J. Walker, and made by Dr. Bergroth¶ the type of a new genus—Halovelia.

Of the same general build as Velia, but with narrower body and much longer and more slender legs, the true "pond-skaters"—various species of the genus Gerris—may be seen disporting themselves, both in winter and summer, on stagnant and running fresh-waters in our islands. The only insects that venture on a life on the "high seas" are near relations of these familiar aquatic Bugs. Of course the oceanic habit has been gained by degrees, and the gradual process of modification can be traced among the related genera.

The aquatic Bugs of the genus Metrocoris** differ from those of Gerris, among other characters, in the much shortened hind-body beyond which the wings, when at rest, extend for a considerable distance. Some of the species inhabit fresh-waters in the eastern tropics, while others, in which the wings are absent, are found on the surface of salt-water in estuaries and harbours. These wingless bugs were classed with the oceanic Halobates to be described below, until Dr. Buchanan White referred them to a distinct genus Halobatodes. Recently Dr. Meinert has shown that, in some cases at least, these estuarine insects must be regarded as "undeveloped forms" of their winged fresh-water relations.

‖ G. H. Carpenter. "A new Marine Hydrometrid." *Ent. Mo. Mag.* (2) Vol. IX., 1898, pp. 78-81, 109-111, pl. III.—G. C. Champion. "Biologia Centrali Americani." Hemiptera-Heteroptera, Vol. II., 1898, pp. 140-1, pl. 9.—G. W. Kirkaldy. "Aquatic Rhynchota." *Bollet. dei Musei di Torino*, Vol. XIV., 1899, No. 350, pp. 4-6.

¶ E. Bergroth. "On two Halophilous Hemiptera." *Ent. Mo. Mag.* (2) Vol. IV., 1893, pp. 277-9.

** F. Meinert. "Slaegten Metrocoris og dens 'Forma præmatura' Halobatodes." *Entom. Meddels.*, Vol. I., 1888, p. 140.

We see, therefore, insects in the very act of adopting a marine life and losing in consequence the power of flight. In several fresh-water Gerridæ—*Velia currens* is a notable example—both winged and wingless adult forms occur. Apparently an insect, whose fresh-water home may occasionally dry up, needs some winged individuals to seek a fresh breeding-place and perpetuate the species. But those who have ventured on the bosom of a great estuary have what is practically a boundless surface of water over which to glide. Wings, therefore, are not only unnecessary, but as we have seen in the case of the marine flies (p. 198, above) rather a source of danger, which can be advantageously given up.

The estuarine Metrocoris, then, with its mixture of winged and wingless species, leads us on to the truly oceanic Halobates, in which wings are altogether unknown. As in marine insects generally, the size of these bugs is small—a body-length of ¼ inch is unusual. They are smooth oval insects, rounded and dark coloured above, flattened and pale below, the body covered with a dense velvety pile that keeps them dry. The fore-legs are rather stout and adapted for seizing floating objects, while the great development and fusion of the two hinder thoracic segments thrusts the long slender middle and hind-legs back to the tail-end of the body, the abdomen being greatly shortened. An especially beautiful adaptation for their surface-walking is seen in the delicate fringe of long hairs borne on the shin and first foot-segment of the legs of the middle pair (Fig. 6).

The earliest discovered species of Halobates were described by the Russian naturalist Eschscholtz in

FIG. 6. FIG. 7.

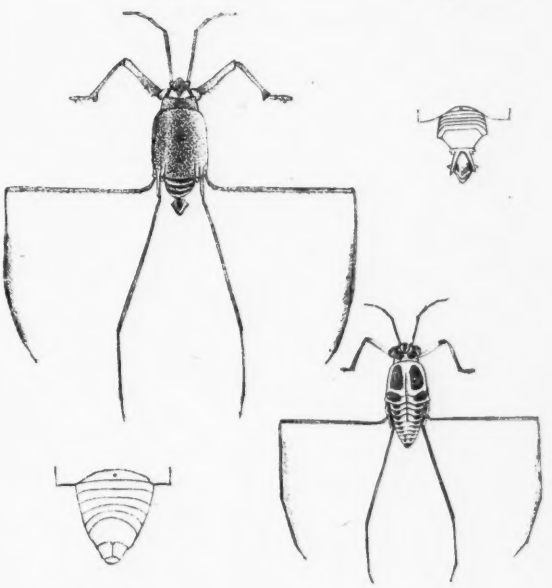


FIG. 8. FIG. 9.

FIG. 6.—*Halobates regalis* (male), Torres Straits. Magnified 4 times.
FIG. 7.—Underside of abdomen (male). } Magnified 6 times.
FIG. 8.—Underside of abdomen (female). }
FIG. 9.—Nymph. Magnified 4 times.

1822. All the references to these insects made by writers during the succeeding sixty years may be found in Buchanan White's admirable monograph of the genus

contributed to the "Challenger" Reports.†† Since his work some studies on the internal anatomy of the insects have been made by Witlaczil and Nassonoff, while our naval entomologist Mr. J. J. Walker has contributed some valuable observations on their habits and life history.

The most striking features of internal structure are the presence in the thorax of organs usually found in the abdomen (on account of the great reduction of the latter region) and the immense development of the muscles for working the long middle and hind legs. A remarkable gland ("belly-gland" of Nassonoff) opens beneath the foremost abdominal segment in both sexes. The tail end of the body is highly modified in the male (Figs. 7-8).

Fifteen species are known, most of which are restricted to one or other of the great oceans, but *Halobates sericeus*, Eschs. occurs both in the Atlantic and Pacific, while *H. micans*, Eschs. (= *Wullerstorfi*, Frauenf.) ranges over the whole oceanic area of the tropics. Apparently these insects cannot exist without a considerable amount of heat, as they are almost unknown on the temperate seas; stray examples of *H. micans* have occurred as far north as Spain and Carolina. They abound most near the shores, and have even been observed jumping about seaweed cast up on the Red Sea beach. But they have been noticed more than 1000 miles from any land. Their brick-red eggs are very large as compared with the size of the mother, who sometimes carries two or three about attached to the under surface of her body. Witlaczil records that the Italian surveying ship "Vettor Pisani" picked up in the Pacific Ocean, off Galapagos Island, a floating bird's feather covered with masses of eggs of Halobates, surrounded with a gelatinous envelope. It seems therefore that the eggs are laid on floating objects.

Floating objects, indeed, serve these tiny ocean-travellers with much-needed rest and food. They have been noticed clinging by their anchor-like fore-claws to masses of seaweed and they suck the juices of jelly-fish. Their fresh-water relations, the pond-skaters, are often described as predaceous, but they seem to prefer a dead or dying to a living victim. Probably, therefore Halobates are to be reckoned among the scavengers of the sea. Of their manner of life, Mr. Walker writes:—"In tropical latitudes, when a sailing ship is becalmed or a steamer is stopped in a perfectly calm sea, it is not long before little whitish creatures are seen rapidly skimming over the glassy surface with a sinuous motion, and soon half a dozen or more Halobates are in view at once, evidently attracted by the bulky hull of the ship, which they will approach frequently within arm's length. Their progress appears to be effected by a sort of skating action of the long ciliated legs. . . . . A heavy swell, provided the weather is quite calm, does not prevent their appearance, but with the ripple caused by the slightest breeze they vanish at once; though sometimes they were to be found in plenty on the narrow belt of smooth water to leeward of the ship, when not one was to be seen on the windward side." Mr. Walker kept specimens alive, confined in a vessel of sea-water. "On the approach of the finger or a pencil they dive readily, and swim with great facility beneath the surface, the air entangled in the pubescence giving them a beautiful appearance like that of a globule of mercury or polished silver. This supply of air must be essential to the existence of the insects, which I feel sure must pass a large part of their life beneath the surface of the sea, diving into undisturbed water in rough or even in moderate weather, and coming up again only when it is absolutely calm."

Considerable difference of opinion has prevailed among the students of these insects as to their exact relationship to their fresh-water allies. Buchanan White considered them a very archaic group, doubted if they ever possessed wings, and, laying stress on their likeness to the young nymphs of the pond-skaters, was inclined to regard them as ancestral to the Gerridæ. Witlaczil and Nassonoff on the other hand consider them highly modified and aberrant forms. There can be little doubt that this latter opinion is nearer the truth, as the loss of wings in marine insects can be traced under our very eyes, notably in the related genus Metrocoris, and the likeness of the pond-skater nymph is much more marked to the young (Fig. 9) than to the adult Halobates. Still, the pelagic life of Halobates shows that a long period must have elapsed since their immediate ancestors forsook the fresh-water for "that great and wide sea wherein are things creeping innumerable, both small and great beasts." Among all the living creatures of the sea few yield in interest and mystery to these frail insects.

It is likely that the animal life of our globe began in the waters of the sea. But the largest monsters of the deep, the great whales and their kindred, together with these "Insects of the Sea," are undoubtedly invaders from the land—driven out of the crowded continents to find a home, if not a resting-place, in that vast ocean which was the cradle of their far-off ancestors in the early ages of the earth's history.

†† F. Buchanan White. "Report on the Pelagic Hemiptera." "Challenger" *Zoology*. Vol. VII.—J. J. Walker. "On the genus Halobates and other Marine Hemiptera." *Ent Mo. Mag.* (2), Vol. IV., 1893, pp. 227-232.—E. Witlaczil. "Zur Kenntnis der Gattung Halobates." *Zool. Anz.*, Vol. X., 1887, pp. 336-9.—N. Nassonoff. "Halobates flaviventris var Kudrini" (in Russian), Warsaw, 1894 (abst. in *Zool. Centrabl.* Vol. I., pp. 702-4). For further modern literature see G. H. Carpenter, "Challenger Expedition." *Nat. Sci.*, Vol. VII., 1895, pp. 60-61.

## CONSTELLATION STUDIES.

By E. Walter Maunder, F.R.A.S.

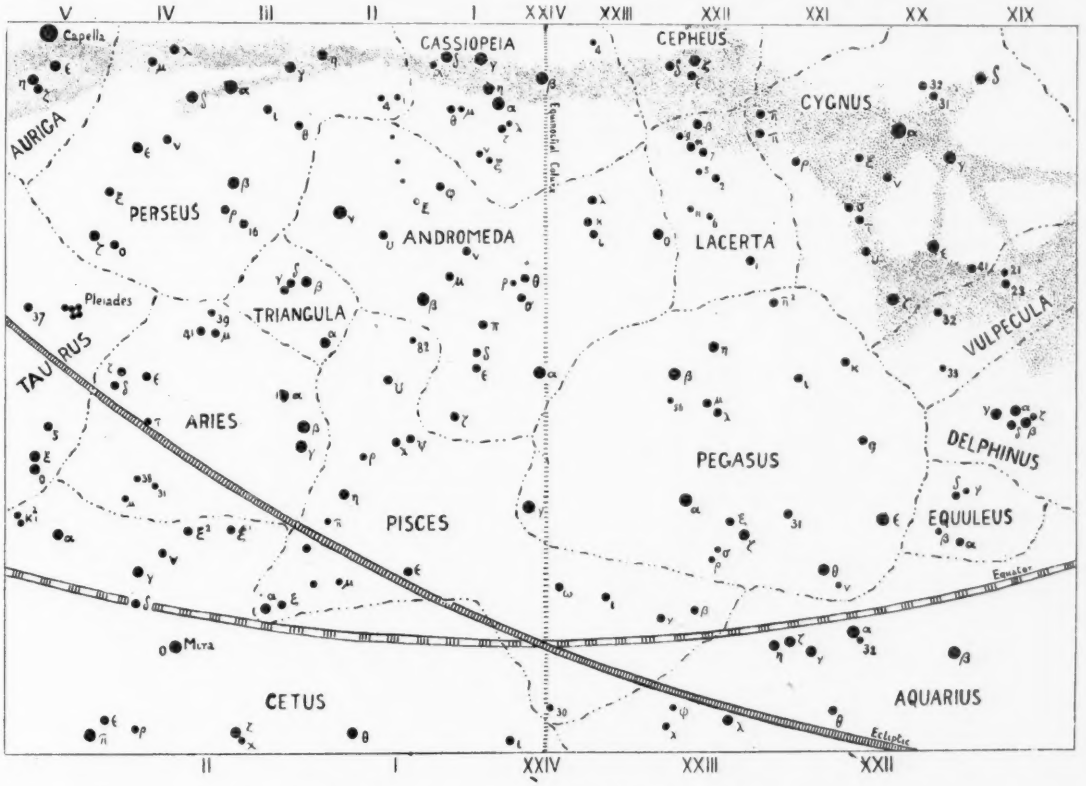
### X.—THE ROYAL FAMILY.

Above the long group of watery constellations, with which we have been occupied of late, and connected with them, may be seen a cluster of constellation figures which, unique amongst the stellar designs, set forth a distinct and well-recognized story. These are the five constellations which, together with Cetus, preserve to us the legend of Perseus and the maiden whom he delivered. The story, as it has come down to us from Greek sources, is one beloved of romancists in all ages and in all lands. A lovely maiden, innocent herself of any fault, is yet condemned, in order to expiate the offences of her parents, to be exposed to some terrible disaster. Her case seems beyond hope or help when at the very crisis of her fate, a young hero who has already abundantly proved his mettle in other fields, appears on the scene. Her beauty and her distress alike appeal to him; and to his victorious powers, her deliverance is a light task. The threatening monster is easily disposed of, and what promised to be a grim and terrible tragedy, ends with triumph and rejoicing to the sound of wedding bells.

It may be, as Brown assures us, that we have in the Andromeda legend but another version of the all-pervading solar myth. Perseus may be Bar-Sav, the son of hair, that is to say, the solar Herakles clad in his

lion's skin, and Andromeda, his bride, the rosy red dawn; but if so, the dead myth has passed through minds who could fill it with a human interest, and so imbue it with the spirit of life. As in the story of Pygmalion, it may be that that which was cold and dead was the original; but surely for us, as for him, the living Galatea is not only more worthy, but is more real and true than the lifeless marble whose form she bore. So, we may still look upon Andromeda and Perseus as no mere abstractions of natural phenomena, but as the innocent persecuted maiden and her gallant deliverer; the old romance, ever new and ever true throughout the ages of the world's long history.

Two of the five constellations, Cassiopeia and Cepheus, were touched upon in the first of these papers. The chief stars of the group now under consideration are




Star Map No. 10; The Region of the Royal Family.

easy to find when once we have found Cassiopeia. When Cassiopeia is in the zenith, as she is about 10 o'clock at this time of the year, then may be seen, high up in the sky, but slightly to the west of the meridian, four stars marking out the corners of a figure which is generally known from its shape as the square of Pegasus. Taking the two upper stars of the square, which are now known as Beta Pegasi and Alpha Andromedae, and proceeding eastward, we find three bright stars at about the distance apart from each other that the stars of the square are, and which are respectively Beta and Gamma Andromedae and Alpha Persei. The latter is readily found. The Milky Way streams down from the zenith, where Cassiopeia is seated, to the east point of the horizon; and along its axis, a chain of bright stars run down from Cassiopeia. The brightest of these is Mirfak, *i.e.*, "elbow," Alpha Persei, marking the elbow of the hero as the word denotes. These three bright stars form the upper points of a greater W just below the smaller, more distinct W of Cassiopeia. The lower points of the W are marked by two stars, Alpha Persei, better known as Algol, the "demon" star, so called from its wonderful variation, and Beta Trianguli, the brightest star in the small but ancient constellation of the Triangle.

This little constellation, insignificant as it is in itself, is of great importance, from the evidence which it supplies that the ancient constellations were the result of deliberate design and forethought. Brown's remarks on this point are so just that I may be forgiven for quoting them. Referring to the type of explanation popular in a certain school, he says:—"They would say that someone noticed these stars, saw they resembled a triangle, called them the Triangle, and everyone else followed suit; a pretended explanation which merely repeats the fact that such a constellation exists." It is clear, as Brown further points out, that there are hundreds of stars which might have been combined in triangles, and which would have equally suggested such a figure. Not a few would have suggested it much more strongly; as, for example, the stars in the head of Taurus. The selection therefore of these by no means conspicuous stars to form the constellation of the Triangle is a strong indication that, not only the designs, but their positions were matters of definite purpose to the old constellation makers.

The principal characteristics of the three constellations, Andromeda, Pegasus and Perseus, as they are

now shown in our star atlases, are preserved for us in the description of Aratus. Of the first he says:—

"Her garlanded head,—her shoulders bare admire—
Her diamond sandalled feet,—her rich attire;
She still in heaven her captive form retains,
And on her wrists still hang the galling chains."

His description of the constellation of Pegasus is one of the fullest and most detailed of any. There is no need, however, to quote the whole, but he calls attention to the circumstance that the star, now known as Alpha Andromedae, the upper left hand star of the square, is common to the two constellations. Its name, Alpheratz, "the Horse," perpetuates the same tradition—

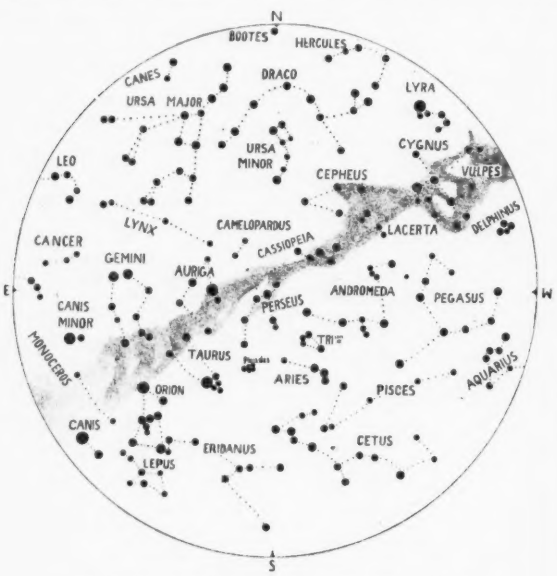
"Close and above her head the wondrous steed,
With hoof and wing exerts a double speed.
So close they meet, one brilliant star they share;
Its body it adorns, and decks her hair.
His side and shoulder with three others graced
As if by art at equal distance placed."

That is to say, these three with the star common to the two figures make up the square.

Of Perseus, Aratus says, after referring to Andromeda:—

"Her anxious eyes
Gleam bright with hope; beneath her Perseus flies,
Her brave deliverer—mighty son of Jove—
His giant strides the blue vault climb and move
A cloud of dust in heaven. His falchion bare
Reaches his honoured step-dame's golden chair."

The "cloud of dust" alluded to is the Milky Way, on an arm of which, Mirfak, the chief star of the constellation, stands. This "dust" round Mirfak supplies perhaps the finest field for an opera-glass in the entire sky; the whole region being full of winding streams of stars of the most attractive form. Moving upward from Alpha towards Cassiopeia, we pass through Gamma and Eta Persei. From Eta Persei, half-way to Delta




The Midnight Sky for London, 1901, November 6.

Cassiopeia, lies a cloudy object, the great cluster of Perseus, one of the finest sights the heavens have to present. Then, again, in the centre of the triangle formed by Gamma Persei, Gamma Andromedae and Algol, lies the comet-like cluster, 34 Messier. Crossing over to the constellation of Andromeda, Gamma Andromedae marks the neighbourhood of the shower of meteors associated with Biela's comet, and now encountering our earth about November 23. Passing on to Beta Andromedae, we find that the starting point of a line of three stars pointing upwards towards Cassiopeia. The next of these stars to Beta is Mu, the third Nu, close to which, towards the east, lies the great nebula of Andromeda, 32 Messier—after the great nebula in Orion the finest example of that order in our skies.

The entire region of Perseus repays examination with the opera-glass, and of Andromeda the regions nearest the Milky Way. Pegasus is much less interesting, but possesses a naked-eye double in Pi, the star in the horse's hoof.

Two small constellations in this region of the sky may receive a passing notice. Immediately below the Dolphin and close by the head of Pegasus, is the little group Equuleus, the "Forepart of a Horse." It is placed in the sky in such a manner as to suggest that Pegasus is not rushing through heaven alone, but is in close company with a yoke fellow, whose head, indeed, is just seen, but whose body is hidden from us by that of Pegasus. The constellation is not mentioned by Aratus, but it is stated that Hipparchus formed it from stars formerly belonging to the Dolphin. It is described as we now have it in the catalogue of Ptolemy.

The other group is Lacerta, the Lizard, a few faint stars gathered together by Hevelius to form a constellation fitted in between Cepheus, Cygnus, Pegasus and Andromeda. Except that it marks the radiant point of the Lacertids, a meteor shower, active in August and September, there is nothing to distinguish the group. Apparently at one time the fore leg of Pegasus crossed this region, since Pi Cygni, which lies beyond it from Pegasus, bears the name Azelfafage, the "hoof of the horse."

## NOVA PERSEI.

By E. M. ANTONIADI, F.R.A.S.

ON a photograph taken at Juvisy by the writer on August 19 last, with M. Flammarion's portrait lens of 6½ in. aperture and 27½ in. focal length, the image of the *Nova* appeared quite different from that of the stars. The exposure was 30 minutes only, so that the image measured only about $\frac{1}{100}$ inch in diameter. Its peculiarity lay in the fact that whereas ordinary stars impress the plate as slightly "nebulous," radiating discs, the *Nova* showed a strong, sharply defined "penumbra," round a small, dark nucleus. The diameter of this "aureola" was 2′. On the whole, the appearance was not unlike that of a normal, quiescent, sunspot.

The following night, August 20-21, proved admirably transparent, and a plate was tried from 23h. 26m. to 3h. 6m. G. M. T., with an effective exposure of some 3 hours and 20 minutes. On this negative, the 2′ "aureola" is quite black. But the *Nova* is surrounded by another one of 6′. Enlarged views of these images will be found in the annexed figure, carefully drawn by the writer from the originals, while the Plate gives photographic enlargements of them.

Notwithstanding the fact that a few weeks before these photographs were taken, the spectrum of the *Nova* had drifted into that of a nebula, it was obvious that the "nebulosity" round the image of the star could not be real. Its sharp boundaries, which repeated all the optical defects of the object glass, precluded the possibility of such an interpretation. This view was, therefore, communicated to Mr. Crommelin, of the Royal

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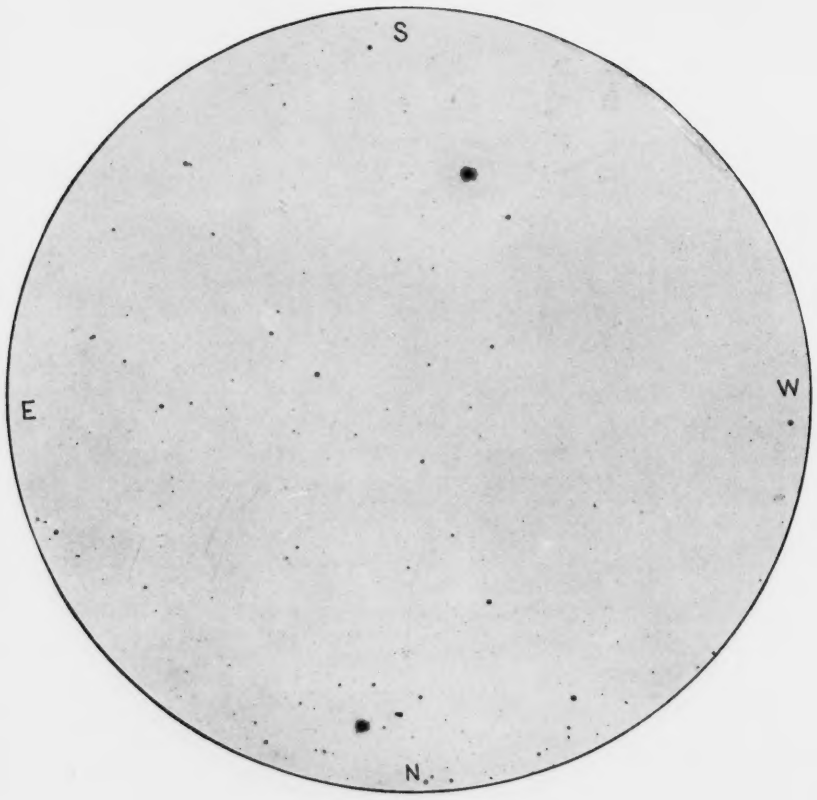
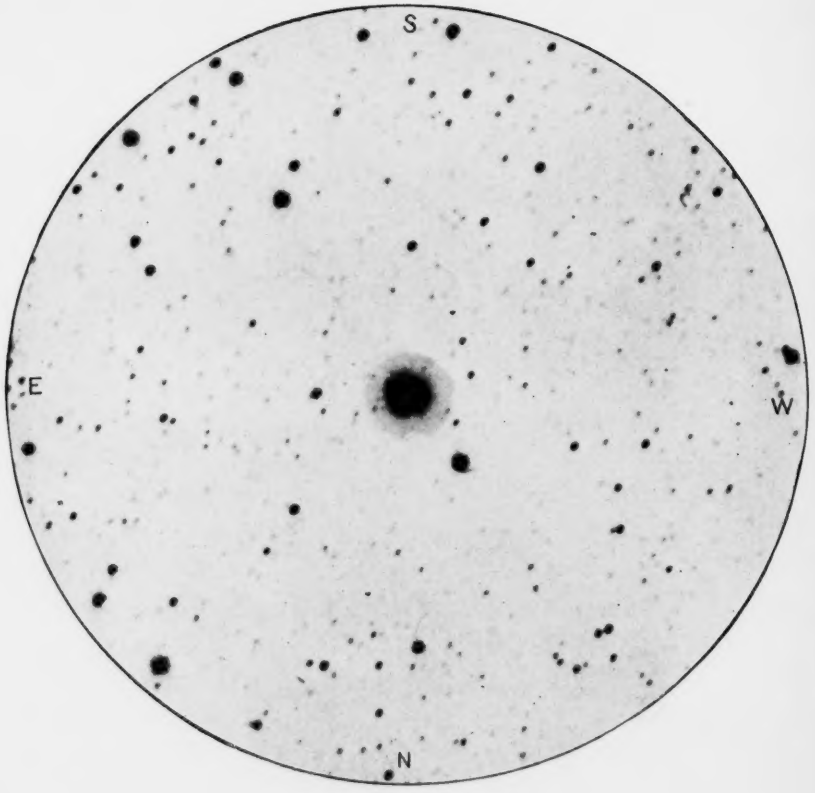
# PHOTOGRAPHIC IMAGES OF NOVA (3, 1901) PERSEI.




LESSER "AUREOLA."

1901, Aug. 19. Exposure = 0h. 30m. Enlargement of 6·2 times the original.




LARGER "AUREOLA."

1901, Aug. 20–21. Exposure = 3h. 20m. Enlargement of 9·0 times the original.

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Observatory, Greenwich, in the following terms (Aug. 21):—"A careful consideration of the various negatives led me to the conclusion that the 'sharp penumbra' round the *Nova's* photographic image is not objective—that is, I do not consider it as a real nebulosity. Its

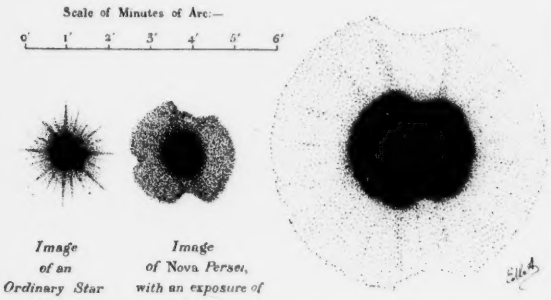


*Image of an Ordinary Star with the 6½ in. Lens.*

*Image of Nova Persei, with an exposure of 0ʰ 30ᵐ. 1901, August 19.*

*Image of the Nova with an exposure of 3ʰ 20ᵐ. 1901, August 20.*

radiated structure makes me rather think that the phenomenon might be due to a difference in the nature of the *Nova's* light, as compared to that of the other stars." The answer was (Aug. 23):—"Mr. Ellis noticed last March that its image was much less sharp than other stars. I believe his photographs were taken with a reflector, so that a difference in the quality of its light would not explain this, though it might in the case of photographs taken with a refractor, as I believe yours were." It will be seen that this reply of Mr. Crommelin's hits at once upon the right interpretation, as drawing attention to the possibility that the *Nova* might emit rays for which the object glass is not corrected—an idea which received an experimental corroboration, a few hours later, at the hands of Prof. Max Wolf, of Heidelberg, who, by stopping one-half of his glass, so as to give the exposed part a semicircular form, obtained a semicircular "aureola" on the plate. In a recent letter, Prof. Wolf attributes the lesser "aureola" to green rays, the larger one to violet. The subject is worth closer investigation, and it would be interesting to have the opinions of our best authorities on it.

## Letter.

[The Editors do not hold themselves responsible for the opinions or statements of correspondents.]

### AMONGST ANTARCTIC ICEBERGS.

TO THE EDITORS OF KNOWLEDGE.

SIRS,—Having quite lately returned to England from New Zealand, *viâ* Cape Horn, I think an account of our voyage—as it proved a somewhat eventful one—may interest your readers. I was a passenger on board one of the New Zealand Shipping Company's newest and finest ships, and those who know that company, will not need to be told we were in excellent hands with the commodore of their fleet as our commander. We left Wellington on Thursday afternoon, August 15th, and put on an extra Friday, which we called "Antipodes" (as we were crossing the Meridian which passes through the Islands of that name), and thus lived through the 16th day of the month a second time in order to make our dates tally on arrival in England. By Tuesday, 20th, therefore, we had made a six days' run from New Zealand, and at mid-day we were at 56.14 S., 151.04 W., with a light easterly breeze, and the sky overcast. We had nearly finished dinner that evening at about 7.15 o'clock, when the captain and the chief officer were both called away. News at sea spreads like wildfire, and it was but a few minutes afterwards that everyone knew there was a very large iceberg on our port side. It also requires but little to get up excitement at sea; and we were more or less all taken by surprise, as it is the rarest occurrence to pass an iceberg, even in those latitudes, in the month of August or even in September, as it is then only just past mid-winter. It had been *intensely* cold all day, with a feeling in the air which no doubt accounts for the sailors' expression of "smelling ice." Very soon we had another iceberg to our starboard. A few minutes later and we had three about us, then seven, and by the time we turned in we had the uncomfortable, and somewhat uncanny knowledge that there were no less than twelve icebergs *in sight*; and this at night, so how many there may have been in reality, no one can tell.

There could be but one opinion as to what would happen had the ship run into an iceberg, as we were then at least 1600 knots from land, and but few ships pass that way.

In the morning we awoke to find ourselves surrounded by seventeen icebergs, the number increasing throughout the day, until at one moment I myself counted thirty-two altogether, and there were floes of ice all about us.

On one occasion, during that first night, as we were slowly coasting round a monster of about three miles long, the captain suddenly discovered that it was joined *under the water to* a berg on our other side. A great block had probably fallen away. It was just towards dawn and the light was so extremely bad that it was just a mere chance that the rippling of water over the covered ice showed our danger. To have continued would have meant certain disaster. The starboard engine was at once reversed so that the ship might turn more quickly than she could have answered to the rudder, and we rounded our adversary on the southern side. We were amongst the icebergs altogether about sixty hours, for it was not before Friday at mid-day that we were finally clear of them. Not only were they quite unexpected, but neither the captain (in over fifty voyages round the world) nor any of the officers in all their experience had ever come across icebergs either in size or number to equal those which made ours a record voyage.

Some idea of the number passed in the space of two days and a half may be formed when I say that 707 really large bergs were actually *sighted*; and it was estimated that altogether we must have passed about 1200 of them. In size they were gigantic. Some were one, two, and three miles in length, and one was five miles long. In height they varied from 50 to 450 feet, and one had a peak considerably higher. (These measurements were taken by sextant.) When it is considered that only 1/7th of an iceberg's bulk is visible above water, some idea of their stupendous size may be gained from the above measurements. The captain could only suggest as a reason for their presence at such an unwonted time of year, and in such numbers and magnitude, that some great volcanic disturbance had taken place in the Antarctic regions, probably caused by the active volcanoes, Mount Erebus and Mount Terror, in whose neighbourhood hot springs are

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known to exist. No ordinary circumstances could apparently have accounted for their size or number. As to their beauty there can be no question. They assume every sort of appearance from the grotesque to the magnificent, and from the weird to the wonderful. One will resemble a mountain with a village perched on its side; another will make one think of an enormous arm-chair, or couch, or perhaps a table; in another we shall see a majestic castle with frowning battlements, turrets and tower complete; or perhaps an animal of the elephantine order will pass before us; or, again, we are greeted by the cliffs of Dover! Some sail along laden with snow, glistening in the sunshine; others are iridescent with all the colours of the rainbow.

H. E. B.

## SOME PECULIAR ANIMAL PRODUCTS.

By R. LYDEKKER.

OF animal wax other than spermaceti (the product of the sperm-whale and certain other allied species) the great producer is the familiar honey-bee, an insect which has been kept in a state of semi-domestication from time immemorial, and is now spread over the greater part of the habitable globe, existing in certain countries in a wild condition. Its original home is, however, quite unknown; and it is doubtful if any of the wild bees of this species are the descendants of primitively wild ancestors. In Southern Europe, as well as in China and Africa, varieties of the honey-bee are met with characterised by the presence of well-marked transverse bands on the body.

As is well known, the wax is secreted by the neuters, or workers, from between the segments of the abdomen. When secreting—a process which occupies about twenty-four hours—the workers cling to one another so as to form long festoon-like masses; the wax exuding as thin plates from between the abdominal segments. These plates are detached by the bees, and conveyed in fragments to the mouth, where they are masticated, and from which they finally issue in the form of a narrow white ribbon. To describe the manner in which the hexagonal-celled combs are built up from the wax thus formed, would be superfluous in the present article. Neither is it necessary to describe the collecting and melting down of the combs to form commercial wax. Nearly related to the honey-bee are certain smaller species inhabiting the warmer parts of South America, and referred to distinct genera, under the names of *Melipona, Trigona,* etc. These likewise build cells with wax, but whether in sufficient quantities to be of any commercial importance, we have not been able to ascertain.

The Chinese obtain a large quantity of excellent wax from an insect they term *pela,* which is a member of the order Rhynchota, and is technically known as *Ceroplastes sinensis.* This insect lives on trees, and is artificially propagated; its wax being employed for the manufacture of the candles used in the Buddhist temples of China and Japan, as well as for medical purposes. An allied species of wax-insect (*Ceroplastes ceriferus*) is found in Ranchi and other districts of India, clinging to the branches of certain kinds of trees, more especially the arjuse, a species of *Terminalia.* As is the case with the Chinese insect, it is the female alone which produces the secretion; this in the present case taking the form of small masses of pure white wax. The late Prof. V. Ball writes as follows concerning this species:—"The Indian wax-insect has never, I believe, been propagated, nor has the wild product ever been collected in quantity. It seems to be—although undoubtedly of value—a substance which would scarcely repay an expenditure of European time and capital; but were the natives to take up its cultivation they might very possibly make it a profitable undertaking."

Of very considerable commercial importance is the resinous substance known as lac, since it forms the foundation of most varnishes, and is also employed in the manufacture of sealing-wax, etc. It is the product of the lac-insect (*Carteria lacca*), an inhabitant of India and other oriental countries, and a near relation of the cochineal-insect, as well as a distant cousin of the plant-lice, or aphides. This insect gives rise to a resinous exudation from the bark of the trees it frequents, which, while still adhering to the twigs is termed stick-lac. When pounded and freed from colouring matter, this substance forms the seed-lac and shell-lac of commerce; while the liberated colouring matter constitutes lac-dye. As neither the resinous matter nor the dye are obtained from the body of the insect, they are not, properly speaking, animal products. Nevertheless, as they are caused by the presence of the insect, and are always spoken of in connection with the latter, they should be considered with such products.

Owing to sudden and large fluctuations in the price of lac in the London market, the trade is a somewhat risky one; the profits made in one year being not unfrequently swallowed up by the losses of its successor. Here it may be mentioned that the word lac, or lakh, is the Hindustani term for 100,000, and is applied to the insect on account of its numbers, while it is also in general use to denote the sum of 100,000 rupees.

The following account of the collection and manufacture of lac in the Ranchi district, India, is given by the writer just cited.* After mentioning that the lac-insect frequents the twigs of various jungle trees, and more especially three particular species, Prof. Ball proceeds as follows:—"To some extent the lac is found occurring, so to speak, spontaneously, and is collected by the forest tribes, and brought by them to the fairs and bazaars for sale. Where, however, there is a regular trade in stick-lac, propagation of the insect is systematically carried on by those who wish for a certain and abundant crop. This propagation is effected by tying small twigs, on which are crowded the eggs or larvæ of the insect, to the branches of the trees. These larvæ are technically called 'seed.' The larvæ shortly after sowing spread themselves over the branches, and, taking up positions, secrete round themselves a hard crust of lac, which gradually spreads till it nearly completes the circle round the twig. At the proper season the twigs are broken off, and we must suppose them to have passed through several hands, or to have been purchased directly from the collectors by the agents of the manufacturer. On arrival at the factory, they are first placed between two powerful rollers which, by a simple arrangement, admit of any degree of approximation. The lac is then crushed off, and separated from the woody portions by screening; it is next placed in large tubs half-full of water and washed by coolies, who, standing in the tubs, and holding a bar with their hands, stamp and pivot about on their heels and toes until, after a succession of changes, the resulting liquor comes off clear. . . . . The lac, having been dried, is placed in long cylindrical bags of cotton cloth of medium texture, which are about

* "Jungle Life in India," p. 308 (1880).

ten feet long and two inches in diameter. These bags when filled have somewhat the appearance of an enormous Bologna sausage. They are taken to an apartment where there are a number of open charcoal furnaces, before each of which there is one principal operator with two assistants. The former grasps one end of the long sausage in his left hand, and slowly revolves it in front of the fire; at the same time one of the assistants, seated as far off as the sausage is long, twists it in the opposite direction. The roasting before the glowing charcoal soon melts the lac in the portion nearest the operator's hand, and the twisting of the cloth causes it to exude and drop into a trough placed below. The troughs which I saw in use were simply leaves of the American aloe. When a sufficient quantity in a molten condition is ready in the trough, the operator takes it up in a wooden spoon and places it on a wooden cylinder some eight or ten inches in diameter, the upper half of which is covered with sheet brass. The stand which supports this cylinder gives it a sloping direction away from the operator. The other assistant now steps forward holding a strip of the aloe between his hands, and with a rapid and dexterous draw of this, the lac is at once spread into a sheet of uniform thickness which covers the upper portion of the cylinder. The operator now cuts off the upper edge with a pair of scissors, and the sheet is then lifted up by the assistant, who waves it about a moment or two in the air, until it becomes quite crisp. It is then held up to the light, and any impurities, technically 'grit,' are punched out of the brittle sheet by the finger. . . . The sheets are placed in packing-cases, and when subjected to pressure break into numbers of fragments."

Previous to the discovery and extensive employment of aniline colours the substance known as lac-dye formed an important and valuable item among oriental animal products. As already mentioned, it is obtained by washing stick-lac in the course of its conversion into shell-lac. Unlike the latter substance it appears, however, to be of exclusively animal origin, being in fact the actual body of the lac-insect, and not a separate secretion.

In the manufacture of lac-dye in India the red liquor obtained from washing stick-lac is first of all strained through some textile fabric, in order to remove all portions of woody matter and other foreign substances. "It is then," to quote once more from Prof. Ball, "poured into large vats, where it is allowed to settle; the sediment is subjected to various washings, and at last allowed to settle finally, the supernatant liquor being drawn off. The sediment, when it is of the proper consistency, is placed in presses, from which it is taken out in the form of hard, dark, purple cakes, with the manufacturer's trade-mark impressed upon them. By the addition of mordants, this dark purple substance yields the most brilliant scarlet dyes, which are not inferior, I believe, to those produced by cochineal itself."

Of greater repute and of more importance than lac-dye is cochineal, which is the source of artists' carmine and carmine-lake, while when precipitated with a salt of tin, it also yields a splendid scarlet. The cochineal insect, of which the female, like that of the nearly allied lac-insect, alone yields the dye, is originally a native of Mexico, where it is parasitic on the leaves of the prickly-pear. The males of the *Coccus cacti*, as the species is called, are minute insects furnished with well-developed wings, feathered antennæ, and a long pair of hair-like processes at the hinder extremity of the body. On the other hand, the female is a repulsive-looking, wingless creature, with very short posterior hairs, and nearly double the size of her partner. These insects adhere tightly to the smooth surface of the fleshy leaves of the prickly-pear; and are not unlike small purple wood-lice in general appearance.

The following account of the cochineal-harvest is extracted from the English edition of Figuier's "Insect World." "These insects are collected when the females are about to lay, that is, when a few young are hatched. It is when the females are pregnant that they contain the greatest amount of colouring matter. When the harvest-time has arrived, the cultivators stretch out on the ground pieces of linen at the foot of the plants, and detach the cochineals from them, brushing the plants with a rather hard brush, or scraping them off with a blunt knife. If the season be favourable, the operation may be repeated three times in the course of the year in the same plantation. The insects thus collected are killed by dipping into boiling water, by being put into an oven, or by being placed on a plate of hot iron. When withdrawn from the boiling water they are placed on strainers in an airy position, first in the sun, and afterwards in the shade. During their immersion they lose the white powder with which they are covered in life. In this state they are called *ronagridas* by the Mexicans. Those that have passed through the oven they term *jaspeadas*; these are ashy grey in colour, but those which have been placed on the hot plate become blackened, and are hence called *negras*. In commerce three sets of cochineal are recognised; first, the *mastique*, of a reddish colour, with a more or less abundant glaucous powder; secondly, the *noir*, which is large, and blackish brown in colour; and, thirdly, the *sylvestre*, which is smaller and of a reddish colour. This last description, which is gathered from wild cacti, is the most highly esteemed of all. Each year there are imported into France 200,000 kilogrammes of cochineal insects, which represent a value of about three million francs."

The cochineal trade is chiefly in the hands of the Spanish and the French. By the latter government these insects have been successfully introduced into Algeria, where they yield a large revenue. About the middle of the last century the government were accustomed to purchase the entire harvest, at the rate of fifteen francs the kilogramme. At a still earlier date they were introduced into the Canaries, where they have also become well established; but the attempts to acclimatize them in Corsica and the south of France resulted in failure.

In the early days of civilization, long before America was dreamt of, carmine was furnished by two European insects belonging to the family *Coccidæ*. The first of these is *Cermes vermilio*, the kokkos of the ancient Greeks, and the kermes or alkermes of the Arabs and Persians. The females of this species are found adhering to the twigs of the kermes oak (*Quercus coccifera*), which grows in dry districts throughout most of the Mediterranean countries of Europe. On their native oaks the insects form dry brittle masses, which were (and perhaps still are) collected by the peasants in the south of France. When separated and completely dried, they are known as *graines de kermes*. In appearance they may be likened to purple currants; and when subjected to suitable treatment they yield a splendid red dye.

The second species is the Polish kermes (*Porphyrophyra polonica*), which once attained great celebrity

under the name of the scarlet grains of Poland. The females of this insect frequent in great numbers the roots of a plant belonging to the genus *Scleranthus*, and are common in many parts of Poland and Germany, as well as in other districts of Central Europe. Towards the end of June the bodies of the females become greatly distended with a purple fluid; and it was at this time of the year that they were formerly collected in great numbers for the dyer. Now, however, they are superseded in commerce by cochineal and lac, although it is probable that their product is still employed to a certain extent locally.

An animal dye that has completely disappeared from use is the celebrated Tyrian purple of the ancients. Whether the dye, as originally manufactured, really had the splendid tint accorded to it by tradition, is unfortunately now impossible to determine. This dye is yielded by the common dog-winkle (*Purpura lapillus*), and may best be obtained by crushing the shell carefully and extracting the fluid from a white vein situated near the head. When first applied to linen this fluid makes a green stain, which if exposed to sunshine gradually changes to deep purple red. If the linen be washed with soap in hot water a further change to bright crimson will take place; this being permanent, without the aid of any mordant. Owing to the mixture of mucus with the pigment, linen dyed with it has always a blotched appearance; but whether the ancients had means of making the colour spread uniformly is not known. A purple dye may also be obtained from the posthorn pond-snail (*Planorbis corneus*).

The dark pigment sepia, which consists of the dried contents of the ink-bag of various cuttle-fish and squids, is on the other hand, an article of considerable value. It was formerly used as a writing fluid, and appears to have been employed in painting by the Chinese from time immemorial. Some years ago it was stated that the *sepia* of the water-colour artist was made of lamp-black; but although that substance may be employed for cheap imitations, the genuine article is still the product of the cuttle-fish and squid. Large quantities of the dried ink-bags of these molluscs are received by artists' colourmen for manufacture into sepia. And some firms regularly send their agents among the fishermen on our southern coasts for the purpose of collecting the ink-bags. These are saved by the fishermen when cutting up squids and cuttles for bait; and it has been suggested that the Newfoundland fishermen, who annually destroy a large number of these molluscs, might make a considerable revenue by saving and selling their ink-bags.

## British Ornithological Notes.

*Conducted by* HARRY F. WITHERBY, F.Z.S., M.B.O.U.

WRYNECK CALLING IN AUGUST AND SEPTEMBER.—The Wryneck arrives here in large numbers about the beginning of April, and is heard constantly until the end of June or the beginning of July, but seldom later, although it remains with us until September. The latest date on which I heard one last year was July 3rd. This year I heard one as late as July 10th, as I thought for the last time this season, but a Wryneck was calling several times at one spot on August 19th, and since that date either a friend or myself heard the bird nearly every day up to September 10th, after which date it ceased calling.—BASIL T. ROWSELL, Guernsey.

*Wood-Sandpiper in Co. Dublin* (*Irish Naturalist*, October, 1901, p. 205).—Mr. W. J. Williams records that on August 19th he shot a Wood-Sandpiper, in immature plumage, on a piece of marshy ground near Sutton, Co Dublin. This is only the fifth specimen of this bird recorded from Ireland.

*The Nesting of the Redstart and Willow Wren in Shetland in 1901* (*Annals of Scottish Natural History*, October, 1901, pp. 194-196).—Mr. Charles A. Sturrock gives an account of a pair of Redstarts which he found nesting at Spiggie, in Shetland. He also found two incomplete nests of the Willow Wren in the island. Neither of the birds seem to have been hitherto recognised as a breeding species in Shetland.

*Lesser Tern Nesting at Barra* (*Annals of Scottish Natural History*, October, 1901, p. 237).—Mr. W. L. MacGillivray writes that five pairs of Lesser Terns appeared at a small island off Barra on June 28th last, and eggs were found on July 4th. These birds nest on Tiree, but have not before nested on Barra, which is a decided westward extension of their normal range.

***All contributions to the column, either in the way of notes or photographs, should be forwarded to*** HARRY F. WITHERBY, ***at 10, St. Germans Place, Blackheath, Kent.***

## Notices of Books.

"THE STALK-EYED CRUSTACEA OF BRITISH GUIANA, WEST INDIES, AND BERMUDA." By Charles G. Young, M.A., M.D., Dublin, Member of the Royal Irish Academy, lately of the British Guiana Medical Service. (London: John M. Watkins, 53, St. Martin's Lane.) 1900. Price 12s. 6d. net. Illustrated.—The plates, coloured from living specimens of tropical crabs, are an attractive feature of this volume. They are pleasantly suggestive of personal intimacy between the author and his subject. The numerous little "thumb-nail" sketches of carapaces and other distinctive parts will be helpful to many readers. Those who avail themselves of Dr. Young's assistance for classifying collections from West Indian and the neighbouring waters will rejoice in the synoptic tables of families, genera, and species, which his book supplies. One could wish, indeed, that the present edition might be speedily bought up by those whom it is adapted to please and benefit, to make room for another on a different model. The book would have to be entirely re-cast to satisfy the requirements of the scientific student. In the first place, that exacting person would wish to pay less and receive more, and he could no doubt be gratified by a judicious treatment of the space and expenditure that have been devoted to the existing production. The luxurious printing of it is out of place in a manual. In a work of imagination by Pierre Loti it may be reasonable to separate one effort of genius from another by a large interval of blank paper. But no one wants to take a long breath between one borrowed description of a species and the next, or to turn over more pages than is absolutely necessary in searching for purely technical details. There are here no fanciful speculations, no original discussions, no amusing accounts of grotesque forms, queer habits, miscellaneous domiciles, to inveigle the general reader into enthusiasm for the study of these stalk-eyed creatures. What is offered is the dry light of science, and in this respect the enterprise of the publisher and the author's object are so commendable that fault-finding may seem ungracious. It is, however, very necessary with a view to any future improvement. From the plan of his work it was inevitable that Dr. Young should become more or less acquainted with the writings of many eminent carcinologists, and from the list of literature which he gives, his authorities can be traced as near to the present time as the year 1898. He might, therefore, be expected to adopt a fairly modern system of classification. What he does do, is to retain a sub-order "Anomoura" in its old extension, although the Dromiidea which he retains in it have for many years past been excluded from it by a consensus of the most trusted authors. By a procedure still less venial he upholds an order "Stomapoda" in what might be called a prehistoric or antediluvian acceptation of the term. If Latreille jumbled together the gentle *Mysis* with the piratical *Squilla*, at that early date there might be plenty of excuse. To wind up the nineteenth century by re-uniting them, when every possible sanction has been given to their separation, is a strange piece of business. In place of the Stomapoda, science has long acknowledged two very distinct orders, or sub-orders, the Stomatopoda, with its single family of the Squillidæ, in which the branchiæ are developed on appendages of the abdomen, and the Schizopoda, in which these organs of respiration (when present) are connected with members of the head and thorax. Of the second group, which is extremely interesting and diversified, Dr. Young mentions not one single example, nor even alludes to the fact that it is embraced in his definition of the sub-order. If, peradventure, his reading allowed him (wrongly) to infer a total

absence of the otherwise cosmopolitan schizopods from West Indian waters, so exceptional a circumstance called at least for some remark. As matters stand, the unwary reader is invited to find among the Squillidæ a set of characters, with half of which they have absolutely no concern. For a book which is nothing if not instructive, it must be said that the synonymy is plotted out in an exasperating manner, as though the object were to cover as much space with as little information as possible. Against the technical names the names of authors are given, but without dates, and often in a random, or at least unintelligible order, and without any indication of the work in which this or that author first defined this or that genus and species, or for any reason changed its original appellation. This method, or no method, may best be illustrated by an example, not selected, but taken from a casual opening of the volume. On page 94 we read:—

"*Mithrax (Mithrax) sculptus.*

" *Mithrax sculptus* . . A. Milne Edwards, Gibbes.
" *Mithrax minutus* . . Saussure, Desbonne and Schramm.
" *Maia sculpta* . . . Lamarck.
" *Mithraculus coronatus* . White.
" *Mithraculus sculptus* . Stimpson."

A plain man would naturally infer from this that Alphonse Milne Edwards used the name *Mithrax sculptus* before it was adopted by Gibbes, and that Lamarck wrote at a later period than Saussure. It would be unfortunate for a plain man to back his inference by any large stake. Lamarck is the earliest author of all those mentioned in this list. Gibbes was anterior to Alphonse Milne Edwards. It was not Alphonse, but his father Henri who preceded Gibbes in calling the species *Mithrax sculptus*. Alphonse called it *Mithraculus sculptus* in agreement with Stimpson. Under the next species the synonymy gives "*Mithraculus cinctimanus*, A. Milne Edwards, Stimpson," though it was instituted by Stimpson in 1860, and not recorded by A. Milne Edwards till 1875. All this detail has been long ago worked out with care and minuteness, and stands recorded plain for all folk to see in the easily accessible "Proceedings of the U.S. National Museum" for 1892. It must rank among the curiosities of literature that anyone should attempt a compilation having for its subject American crustacea, and yet ignore or be ignorant of a whole series of writings by approved American authors on this very subject. The existence of Stimpson, as we have seen, is recognised. Acknowledgments are made to Miss Rathbun. Some of their writings are cited in the introductory list of literature. Others of equal importance are left unnoticed. But among those included in the list will be found Stimpson's "Notes on North American Crustacea," Parts I. and II. These are not voluminous contributions. Nevertheless, *Actæa erosa* from the coral reefs of Florida, *Clibanarius antillensis* from Barbados, and several other species therein described by Stimpson, are entirely passed over by Dr. Young, though proper to the region with which his book is concerned. That *Uhlias limbatus*, from St. Thomas and other genera and species, instituted in the third part of the same series of notes, have suffered the same neglect, is perhaps most easily accounted for by the theory that Dr. Young never happened to have seen or heard of this third part. It would be tedious here to demonstrate the theory, but a student with patience to compare the two works in question is likely to become a believer in it. A similar theory will apply to the monographic paper on the genus *Panopeus*, by Benedict and Rathbun in 1891, to that on the Pericerídæ by M. J. Rathbun in 1892, to the same writer's "Revision of the Nomenclature of the Brachyura" in 1897, as well as to Bigelow's "Stomatopoda of the 'Albatross'" in 1894. No writer could have willingly neglected the invaluable assistance of such contributions. The wonder is that any writer undertaking such a task as Dr. Young's could have escaped acquaintance with them. However, the sun still shines brightly when the spots on its face are dark and numerous, and no doubt the book under review, amidst its imperfections, contains a mass of sound information, and will be acceptable and useful to many. It is, in fact, good enough to make one sincerely wish that it were better.

"THE CAMBRIDGE NATURAL HISTORY; AMPHIBIA AND REPTILES." By Hans Gadow, M.A., F.R.S., etc. (Macmillan.) Illustrated. 17s. net.—It may be truly said of this volume of a valuable series that it is the only thoroughly scientific, and at the same time readable, up-to-date account of the living and extinct members of two very important and interesting group of vertebrates. Dr. Gadow has devoted a great amount of attention both to reptiles and amphibians; and, as might have been expected, he has been led to introduce certain modifications in regard to the scheme of classification of the former group. No true conception of the mutual relationships of the existing groups of reptiles can possibly be entertained without including their extinct relatives, and the author is therefore to be congratulated on the large amount of space he has seen fit to accord to the groups no longer represented among the living fauna of the globe. Very noteworthy are his remarks with regard to Huxley's proposal to brigade the amphibians with the fishes on the one hand, and the reptiles with the birds on the other. Although his objection to this arrangement is veiled in the most polite language, it is nevertheless intended to be a strong one. And while the author lays great stress on the almost complete transition between amphibians, he refuses to believe that the extinct dinosaurs have any sort of relationship with birds. How intimate is the former connection in the author's opinion may be inferred by his proposal to remove certain species hitherto classed with the labyrinthodont amphibians to the reptiles. Neither does Dr. Gadow speak with any less uncertain voice as to the relationship between reptiles and mammals. For after stating that reptiles are derived from the labyrinthodont (or stegocephalous) reptiles, he goes on to say that mammals trace their origin to some branch of the extinct anomodont (theromorphous) reptiles. As to birds, he believes them to have been evolved from some reptilian group at present unknown. The New Zealand tuatera lizard is regarded as the most primitive of all living reptiles, and from its ancestors are considered to be derived the snakes and true lizards. On the other hand, the ancestry of the chelonians and crocodiles is traced to the extinct anomodonts, which also gave rise to the dinosaurs and the great marine saurians of the secondary period. The importance of the anomodonts, some of which so strangely simulate the dentition of modern carnivorous mammals, can therefore be scarcely over-rated. In this connection it is a matter for regret that the recent discovery in Russia of many types of these anomodonts, previously supposed to be confined to South Africa, came too late to be mentioned. Although Dr. Gadow enters somewhat deeply into technical details, his language is for the most part so simple that it can be understood by any reader of average intelligence with a little trouble. One of the most generally interesting subjects touched upon is the history of the so-called giant tortoises of the oceanic islands. One of these, which was handed over to the British with the cession of Mauritius in 1810, still lives at Port Louis, where it was received first in 1766. The impending extinction of these huge chelonians is much to be deplored. Less regret will be felt for the diminution in the numbers of the American alligator, which is now hunted both by whites and Indians for the sake of its hide. The numerous illustrations are all that can be desired, both from the scientific and the artistic point of view; a special feature being the introduction of small maps showing the distribution of various groups. Space, we regret to say, forbids a fuller notice. But it may confidently be said that by this work Dr. Gadow has decidedly enhanced his reputation as one of the foremost students and teachers of vertebrate zoology.

"THE LIFE AND LETTERS OF GILBERT WHITE, OF SELBORNE." Written and edited by his great-grand-nephew Rashleigh Holt-White. (Murray.) 2 vols. Illustrated. 32s.—Except for the brief memoirs in several of the many editions of Gilbert White's "Selborne" (notably that in Bell's edition), and for the life by Prof. Newton in the Dictionary of National Biography, there has been hitherto no connected account of the career of our best beloved naturalist. Although his life was singularly devoid of striking incident, so much interest attaches to White and his Selborne that we welcome an authentic record of his career, and further information regarding his country. Mr. Holt-White apologises for the fact that although not a naturalist himself he has undertaken to write the life of perhaps the best known naturalist, a fact which is responsible for a slight defect in these volumes, since a naturalist could have more clearly explained the value of White's observations, and traced their influence. To some extent this defect is compensated for by many interesting and valuable notes contributed by Prof. Newton. The author's immediate reason for publishing the biography appears to have been to correct many erroneous statements, some occurring in Bell's memoir, concerning the circumstances of the life of Gilbert White. These circumstances refer in the main to the naturalist's character and sentiments, and we need only remark that in our opinion Mr. Holt-White has completely abolished the misconceptions which have arisen. The biography consists chiefly of correspondence between White and his relatives and friends, and of extracts from the Garden and Naturalist's Calendars. Many of these letters have never before been published, and very few of those appearing in the Natural History of Selborne have been here reprinted. They are carefully arranged, and have been well connected and explained. They reveal a great deal of the character of the man, and tell us much that is interesting of his occupations, and of the manner of the life of his times. Although White never went out of England, as far as this country is concerned he was a considerable traveller for his age, and by no means the recluse that he is sometimes pictured. The correspondence with his brother John at Gibraltar reveals his acuteness in detecting even from a description the nature of a bird or beast unknown to him.

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and although his books on natural history were not many, those to which he had access were evidently well read. His love for Selborne and its fauna and flora was, however, the main theme of his life, and his happiest hours were undoubtedly spent in tending his garden, improving his "outlet," and above all in studying the birds, animals, and plants about him. Although he by no means disclaimed systematism it was as living and wild that he delighted to study nature. "Learn as much as possible the manners of animals, they are worth a ream of descriptions," he wrote to his brother at Gibraltar. We are very glad to have a more complete knowledge of the life of the first and greatest of field naturalists, and to be possessed of more of his charming letters. The volumes before us contain many nice illustrations, and we can only regret that no portrait of Gilbert White himself was ever made.

"THE NATURAL HISTORY AND ANTIQUITIES OF SELBORNE." By Gilbert White. Edited, with an introduction and notes, by L. C. Miall, F.R.S., and W. Warde Fowler, M.A. (Methuen.) 6s. —Although over 100 editions of White's Selborne have now been published, the demand for more will surely never fail. The editions lately published have generally possessed some special attraction in the way of illustrations or previously unpublished additions. The present edition contains no illustrations, and no novelty, but being well edited, neatly produced, and of a convenient size, it is none the less welcome. It contains the whole of the original edition of 1789, with the exception of the Appendix of Latin charters and deeds, while the "observations on various parts of nature," extracted from White's diaries by Dr. Aikin, are added. White's spelling and punctuation are "scrupulously retained." The editors have appended notes which are in every way exact and lucid. In the "letters" these notes are inserted wherever necessary, but in the "observations" a few more would have been advantageous, as, for instance, in the observation headed Grosbeak, where it should have been noted that the bird referred to was the Hawfinch. In an Introduction a brief account of the life and character of Gilbert White is given, which would no doubt have been enlarged and, in a few particulars, amended, had Mr. Holt-White's Biography, reviewed above, been accessible. Brief accounts are also given of the lives and works of Thomas Pennant and Daines Barrington, to whom the natural history letters were addressed, and of Richard Chandler, to whom were addressed the letters on the antiquities. The introduction contains besides, a short description of Selborne, and a history of the book itself. Finally, Mr. Warde Fowler contributes an admirable chapter, which is at once clear and brief, on White's view of the migration of birds. In this Mr. Fowler deals specially and with much skill with White's tendency to believe in the "hibernation" of birds. The spectre of "hibernation" haunted almost all White's observations on migration, and produced the only serious errors in his observations, and although he never was able to obtain proof of hibernation in birds his virtual belief in the myth has been undoubtedly the cause of its survival even to the present day. We may add that the present edition is nicely and clearly printed on a rough surfaced paper, which is so much more pleasant to the eyes and the touch than the highly glazed papers at present in vogue.

## BOOKS RECEIVED.

*Occasional Thoughts.* By John B. S. Camp. (Simpkin, Marshall.)

*Dragons of the Air.* By H. G. Seeley, F.R.S. (Methuen.) Ill. 6s.

*Elementary Telephotography.* By Ernest Marriage, F.R.P.S. (Iliffe.) Illustrated. 3s. 6d. net.

*Elementary Algebra.* By C. H. French, M.A., and G. Osborn, M.A. (Churchill.) 4s. 6d.

*The Growth of the Empire.* By Arthur W. Jose. (Murray.) Ill. 6s.

*First Year's Algebra.* By C. H. French, M.A., and G. Osborn, M.A. (Churchill.) 1s. 6d.

*Intermediate Practical Physics.* By John B. Wilkinson. (Chapman & Hall.) Illustrated. 2s 6d.

*A Ready Aid to Distinguish the Commoner Wild Birds of Great Britain.* By David T. Price. (Gurney & Jackson.)

*Don Quixote.* Vol. III. By Miguel de Cervantes Saavedra. Edited by Jas. Fitzmaurice-Kelly. (Gowans & Gray.) 1s. net.

*Story of Fish Life.* By W. P. Pycraft, F.Z.S. (Newnes.) Ill. 1s.

*Zoology.* By A. E. Shipley, M.A., and E. W. McBride, F.A., D.SC. (Cambridge: University Press.) Illustrated. 10s. 6d. net.

*Story of the Isle of Man.* By A. W. Moore, M.A. (Fisher Unwin.) Illustrated. 1s.

*Scientific Roll.* By Alexander Ramsay. (Sharland.) 1s.

*Side and Screw—being Notes on the Theory and Practice of the Game of Billiards.* By C. D. Locock. (Longmans.) Ill. 5s. net.

*Building Construction.* The Organized Science Series. By Bryson Cunningham, B.E., A.M.I.C.E. (Clive.) Illustrated. 2s.

*Practical Histology.* By J. N. Langley, M.A., SC.D., F.R.S. (Macmillan.) 6s.

*Unity of Matter.* By Gustavus Detlef Hinrichs, M.D., LL.D. (St. Louis, Mo., U.S.: Carl Gustav Hinrichs.) $1 net.

*The Play of Man.* By Karl Groos. (Heinemann.)

*Pharynx of the Eristalis Larva.* By J. J. Wilkinson. (Clay.) Illustrated.

*Report on the Scheme of Sewage Purification proposed for Belfast, and its probable Effects on the Lough.* By E. A. Letts, D.SC., PH.D.

*Fitments and Furniture.* By Rev. F. C. Lambert, M.A. (Dawbarn & Ward) 6d. net.

*Climate and Weather of Sevenoaks.* By W. W. Wagstaffe, B.A., F.R.C.S. (Sevenoaks: J. Salmon.)

*Field and other Experiments at Rothamsted.* By Sir J. Henry Gilbert, F.R.S. (Lawes Agricultural Trust Committee.)

*Guide to the Collection of Minerals in the Blackburn Museum.* (Blackburn: *Times* Office.)

Mr. H. J. Glaisher, of Wigmore Street, Cavendish Square, has sent us a useful catalogue of books, comprising details of an excellent collection of volumes, many of which refer to science.

ASTRONOMICAL.—In a recent discussion of data relating to solar radiation, Dr. Buchanan, F.R.S., concludes that under the most favourable circumstances the surface of the earth at sea-level receives heat from the vertical sun at the rate of 1.2 gramme degrees Centigrade per square centimetre per minute, or 1.17 horse-power per square metre. Taking into account the imperfect transparency of our atmosphere, the value of the *solar constant*, or the heating power of the sun's rays upon a surface of one square centimetre exposed to them for one minute at a point on the earth's orbit may perhaps be as much as 1.8 gr.° C. This result accords better with the older values obtained by Pouillet and Herschel than with some of the more modern estimates.

From a large number of measurements made with a filar micrometer on the 26-inch Washington refractor, Dr. See concludes that the diameter of the planet Mercury is $4277.6 \pm 5.8$ kilometres; that is, $2656.4 \pm 3.6$ miles. No markings of any kind were recognised with certainty, and no evidence of an absorbing atmosphere was obtained.

Continuing his interesting and suggestive researches on short-period variables, Dr. A. W. Roberts finds that the mean density of the eight known southern variables of the Algol type is 0.176, the density of water being taken as unity. Of the 22 "Algol" variables at present known, five, including $\beta$ Lyrae, are regarded as binary systems in which the components revolve in contact. Such systems, however, are not permanent, the components diverging on account of tidal action. A regular sequence can be traced from binaries with a period of a few hours to those like Castor having a period of a thousand years.

The Board of Education has this year added "Spherical Astronomy" to the list of science subjects in which examinations will be held next May and June. The syllabus appears to have been carefully drawn up, and doubtless many students will be glad of the opportunity of obtaining certificates for this branch of astronomy. Descriptive and physical astronomy are included in the subject of Physiography, but a separate examination is held in Nautical Astronomy.—A. F.

BOTANICAL.—In *Rhodora* for September, Dr. B. L. Robinson notes a case of "self-strangulation in the Virginian Creeper" (*Ampelopsis quinquefolia*). A tendril from the main stem had wound itself round a higher internode of the same shoot so tightly that further enlargement of the stem at this point ceased. Growth, however, continued above and below, resulting in a deep constriction in which the tendril was buried. In the following spring the part of the stem below the constriction developed leaves as usual, but that above showed unmistakable signs of death. Dr. Robinson remarks that on examining several plants of the Virginian Creeper, he found that it was not unusual for tendrils to attach themselves to the shoots that produce them, but without any injurious results.

Among the plants particularly noteworthy in the new part of *Hooker's Icones Plantarum* are: *Lepinia solomonensis* (Apocynaceæ), remarkable for its curious fruit, consisting of four carpels on very long, arched stalks, and connate at the apex; *Bretschneidera sinensis*, a handsome new genus of Sapindaceæ, from Yunnan, China, allied to the common Horse-chestnut, and named in honour of the recently deceased Dr. E. Bretschneider, author of the elaborate *History of European Botanical Discoveries in China*; *Urnularia*, a new genus of Apocynaceæ from Borneo, interesting on account of one of its species yielding, according to Professor Beccari, a good rubber; *Sympetalandra*, a somewhat anomalous new genus of Leguminosæ, also from Borneo; and the puzzling Mexican *Juliania*, which, though known to botanists for more than half a century, has not been definitely assigned to any natural order: its seed-vessels are singularly characterised by having three collateral or parallel cells.—S. A. S.

ENTOMOLOGICAL.—A fine male specimen of the "Timberman" Longhorn Beetle (*Acanthocinus aedilis*) has been sent to us for identification from New Seaham, Co. Durham, by Mrs. F. M. Sturley. It is a remarkable insect on account of the inordinate length of the feelers. Probably all the specimens which occur in England and Ireland are imported in timber from the north of Europe, but the beetle is believed to be truly indigenous in Scotland.—G. H. C.

ZOOLOGICAL.—Professor Ray Lankester's memoir on the affinities of the great panda (*Æluropus melanoleucus*) of Tibet has just appeared in the *Transactions* of the Linnean Society. It is illustrated by a beautiful plate of the under surface of the skull, displaying the remarkable character of the teeth. Almost synchronously with the appearance of the memoir the mounted specimen of the animal in the Natural History Museum has been placed in a case in company with its relatives, the long-tailed panda and the raccoons.

The October issue of the *Proceedings* of the Zoological Society contains Professor Lankester's diagnosis of the genus *Ocapia*, together with Sir Harry Johnston's account of how he obtained the okapi skin and skulls. A reproduction of the original sketch of the animal by Sir Harry, before the skin was mounted, accompanies the latter communication.

In the same periodical will be found an account of the rediscovery, by Mr. J. G. Millais, of Bechstein's bat in England. The first English examples of this species were taken many years ago in the New Forest; the specimen described by Mr. Millais was captured last March near Henley-on-Thames. This bat must now definitely be included in the British fauna.

Among other new mammals obtained by Sir H. Johnston in Uganda, Mr. O. Thomas describes in the same journal a handsome genet, for which the name *Genetta victoriæ* is suggested. On another page Mr. Walter Rothschild mentions a series of magnificent specimens of the Abyssinian ibex (*Capra vali*) recently obtained by Capt. Powell-Cotton, one of which is now mounted in the Natural History Museum. Previously this splendid species was known only by the type specimens in the Senckenbourg Museum at Frankfort and a few pairs of horns.

It seems as though we never should get to the end of changes in nomenclature. In a recent issue of the *North American Fauna*, now in course of publication by the Agricultural Bureau at Washington, it is proposed to replace *Mephitis*, the well-known title of the true skunks, by *Chincha*; the former name being transferred to the little skunks (*Spilogale*). But there are worse things than this in nomenclature. In a notice of fossil remains from Patagonia, an Argentine writer proposes such unspeakable compounds as *Thomashuxleya*, *Gulielmofloweria*, *Oldfieldthomasia*, and *Asmithwoodwardia*. The only consolation is that they are not likely to come into use, as most, if not all, will probably turn out to be synonyms. Still, something ought to be done to stop such practices.

Not long ago Dr. D. G. Elliot, of the Field Columbian Museum, published a Synopsis of North American Mammals; this, in the Publications of the Museum, he has just followed with a revised list, containing additions and certain amendments in nomenclature. In another paper in the same serial he raises a protest against the excessive multiplication of specific and subspecific names among the smaller American mammals. And in a third, throws doubts on the distinctness of some of the forms of caribou which have been recently named.

The last two numbers of the *Quarterly Journal of Microscopical Science* contain important papers by Mr. R. Evans on the Malayan representatives of that primitive arthropod *Peripatus*, together with remarks on the classification of the different generic types of the group.

In the October issue of the *Transactions* of the Zoological Society, Mr. G. A. Boulenger publishes his third contribution on the fishes collected by Mr. J. E. S. Moore in Lake Tanganyika. The whole collection has shown the striking fact that the peculiar beaked fishes forming the family Mormyridæ, so eminently characteristic of the fresh-waters of Ethiopian Africa generally, are unrepresented in Tanganyika. Another peculiarity is the occurrence in this remarkable lake of a representative of the Asiatic cyprinoid genus *Capoëta*, known elsewhere in Africa only by a single Abyssinian species.

THE INVERNESS EARTHQUAKE.—It is seldom that earthquakes in this country are sufficiently strong to cause much damage to buildings. Within the memory of the present generation, there have been only three—the Essex earthquake of 1884, the Hereford earthquake of 1896, and the earthquake that was felt throughout the north of Scotland shortly before 1.30 a.m. on September 18. There was no considerable destruction of chimney-stacks and roofs in the last case, such as occurred in the neighbourhood of Colchester in 1884, but it is said that few streets in Inverness have escaped some damage of a more or less slight character. Fissures in the ground are a rare result of British earthquakes, and it is therefore worthy of notice that one about 600 yards in length was formed in the north bank of the Caledonian canal

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at a spot a few miles from Inverness. The shock is said to have been felt at Dunbar, Wick, Tobermory, in the island of Mull, and at Aberdeen and Peterhead. Its disturbed area must therefore extend over the greater part of Scotland; and, since it includes Edinburgh (though no record has yet come from that city), it is strange that the shock should not have been registered by the seismograph erected in the Royal Observatory. The explanation probably is that, the boom of the pendulum being placed in a north and south plane, it would only be affected by movements with an east and west component.—C. D.

## THE ALCHEMY OF HOAR-FROST.

By ARTHUR H. BELL.

COOLED surfaces are Nature's plates, upon which she etches some of her most beautiful pictures. In this artistic work she employs many materials, but her choicest effects are obtained through the medium of hoar-frost. Commonly, hoar-frost is described as being merely frozen moisture, but this is not an adequate description of an agent that has the power of adorning in a few hours such prosaic objects as gate-posts and dust-bins with all the trappings of fairy land. Moisture is indeed the fabric out of which all this feathery whiteness is built up, but, although it seems sometimes as if it is distributed in a very capricious manner, there are nevertheless certain definite circumstances which cause the hoar-frost to settle down on some surfaces rather than on others.

On any cold and frosty morning it will usually be found that those surfaces that are the best radiators of heat are also those that are most successful in collecting hoar-frost. It is not always realized, however, that all objects are continually radiating heat, so that no matter how much they may receive from the sun, they are constantly trying to get rid of it. A fern leaf, or a stone, may perhaps receive generous supplies of heat during the day, but as soon as night comes it hurries to spend or radiate it, and the object that is quickest at this work will the soonest become covered in hoar-frost. Everyone has observed how the moisture from the air will settle on the outside of a glass of cold water brought suddenly into a warm room. A similar process takes place in the open air, so that as the currents of moist air travel across surfaces that are very cold, they pay tribute in drops of vapour, which in warm weather take the form of dew, and in cold of hoar-frost. Moisture, therefore, plays a very important part in the development of these hoar-frost pictures; but there must not be too much of it. Some of the most delicate designs occur during the prevalence of mist and haze, and in towns especially it is no uncommon thing for a choking brumous fog to be in some degree compensated for by a subsequent display of copious hoar-frost. As regards discovering what kind of surfaces are best adapted for collecting hoar-frost it may, in passing, be said that a very instructive and entertaining series of observations may be obtained by exposing to the frost cups, dishes, tumblers, saucers, and other glass and china ware, which will be found to accumulate hoar-frost in a varying degree. A brief contemplation of these differences will clearly demonstrate the fact that it is those objects that cool the quickest that make the speediest responses to the alchemy of frost.

In certain parts of the world agriculturists protect their crops from damage by frost by setting light to heaps of rubbish, thus producing clouds of smoke, which check the radiation of heat from the surface of the ground. By this means frosts are warded off and the life of susceptible plants is prolonged. A similar thing happens when real clouds float overhead, it being a common experience that no dew or hoar-frost forms when the night is cloudy. In other words, a canopy of clouds acts towards the earth as an overcoat and prevents the loss of the heat which it received from the sun during the day; for no sooner does this heat attempt to escape into space than the clouds reflect it earthwards again, and they form indeed a veritable trap for sunbeams. But when the air is damp and the stars are shining brightly, the thermometer at the same time being ten or more degrees below the freezing point, everything will be dusted over with fragile flowers of frost, and more especially if there happens to be little or no wind.

During very many years it has been a popular superstition that it is injurious to sleep with the moon shining on one's head. From what has already been said as to the way in which moisture promptly settles on all objects that are radiating their heat quickly, it will be gathered that it is not so much the moonbeams that work the mischief as the loss of warmth and the deposition of moisture which falls on all surfaces exposed to the sky on cold and cloudless nights, when dew and hoar-frost are most abundant.

It is, further, not commonly realized that the atmosphere acts as regards moisture very like a sponge. According to this conception of the case the air is not only able to absorb large quantities of water, but it is also able to retain it; and it is only when something happens to squeeze the atmosphere, as the process may be termed, that the hold on this moisture is relinquished. This squeezing of the atmosphere takes place whenever there is a fall in temperature, this being the great agent or force that precipitates the moisture from the air and causes it to take the form of rain, hail, snow, fog, dew, or hoar-frost; these various forms being regulated by the condition of the atmosphere. Although the air parts so readily with its stores of moisture when the temperature falls, it is to be observed that an increase of temperature greatly enlarges its capacity for moisture. A cubic foot of air having a temperature of 32 deg. can accommodate only 2·13 grains of moisture; but supposing the temperature to be increased to 72 deg. there would then be room for 8·47 grains. It will therefore readily be understood that in looking out for copious displays of hoar-frost, the best pictures will be observed if during moist weather a body of air having a high temperature is suddenly reduced to the freezing point.

One of the best ways of keeping a jar of water cool is to wrap a damp cloth round it; the evaporation of the moisture producing loss of heat. In hot climates this circumstance is, indeed, made of practical service as regards the manufacture of ice, for, so intense is nocturnal evaporation of moisture, that it is found that if water is placed in shallow porous pans overnight, there is a welcome supply of ice in the morning. When, therefore, moisture is evaporating into the atmosphere there is always a loss of heat, so that the greater the amount of vapour passing into the air the greater the amount of heat used up.

It is an interesting fact that when hoar-frost, or dew, or any of the other children of aqueous vapour, spring into being, this heat reappears, or, as it is sometimes conveniently described, latent heat is set free. As regards rainfall the amount of heat liberated is, of course, greater than is the case with hoar-frost. A

fall of one inch of rain means that over every acre of ground a weight of one hundred tons of water has fallen, or 60,000 tons to the square mile. Put in another way, this downpour over such a well-known area as the Thames Valley means that 53,000,000,000 gallons of water have been precipitated from the atmosphere. It has been calculated that the condensation of one gallon of rain gives out enough latent heat to melt 75 lbs. of ice, or to melt 45 lbs. of cast iron. From these figures the mathematically inclined may work out for themselves the amount of heat set free in some tropical downpour when the rain instead of being an inch in depth, is seven or eight. That this liberated heat has great effects on the temperature and movements of the air goes without saying, but this part of the subject must not here be further pursued. It is now sufficient to say that just in the same way that condensing rain gives out heat, so do hoar-frost and dew, and a recognition of this fact has resulted in the suggestion of a rule for foretelling the occurrence of hoar-frost.

The success of this prognostic depends on the fact of there being an intimate relation between the deposition of hoar-frost and the temperature of the dew point, as it is termed. Reference was made above to the circumstance that the amount of moisture a given body of air can hold depends on its temperature. Thus at a temperature of 52 deg. a cubic foot of air is capable of giving accommodation to 4·39 grains of vapour, but at 32 deg. there is room only for 2·13 grains. If, therefore, a body of air at the former temperature is suddenly cooled, its capacity for moisture is correspondingly reduced and some of the aqueous vapour spills over, as it were, or is condensed. From this it will be seen that there is a critical temperature below which any vapour-laden air cannot be reduced without some of the moisture spilling over; this critical temperature being called the dew point. A glass of cold water (to repeat an illustration), when brought into a warm room, reduces the temperature of the air in contact with it to the dew point, so that drops of moisture form on the outside of the glass. Instruments that give the temperature to which the air is thus reduced are called hygrometers, and during frosty weather, as already suggested, a knowledge of this dew point may become exceedingly useful.

If, for instance, in the evening, the hygrometer shows the dew point to be above 32 deg., in the majority of cases there will be no hoar-frost that night. On the other hand, if the dew point is below 32 deg., and if there is a moderate amount of moisture in the air, plenty of hoar-frost may be expected. From what has previously been said it will be seen that this prognostic is capable of a very simple explanation. Latent heat is set free when condensation of moisture takes place, so that when the dew point is above 32 deg., any deposition of moisture results in a little warmth appearing, which is often quite sufficient to ward off hoar-frost. On the other hand, with a dew point below 32 deg., these hidden stores of heat are not sufficient to hold in check the advance of the icy spicules.

But probably the most interesting fact in connection with hoar-frost is its growth, it being no uncommon thing to see favourable surfaces literally submerged in a frosty mantle. Hoar-frost, moreover, is better suited by an atmosphere where moisture is plentiful than when it is not so abundant, these latter conditions being more favourable for the birth of dew-drops. Another consideration is that moisture may be reduced below the freezing point without congealing. It is a common experiment thus to treat moisture, although the slightest shaking of this cooled liquid is enough to change it promptly to a solid form. Similarly as regards the moisture in the atmosphere, there are excellent reasons for supposing that in certain circumstances the vapour may be a degree or two below the freezing point without actually solidifying, and is only waiting the touch that will turn it into a feathery frond of ice. Supposing, then, that moist air in this condition is gently wafted against a bush, a fence, or a blade of grass, the shock, though slight, is quite enough to work a magical transformation. The greater part of these frost effects are thus prepared in the air, and as each body of chilled vapour floats against an object having already upon it a covering of frost, it is, as it were, roused by the shock, and awakening, promptly adds its load of frozen crystals to the growing picture.

## THE WATER OF THE DEAD SEA.

By C. AINSWORTH MITCHELL, B.A., F.I.C.

THERE are few more interesting sites in the world than the large lake which receives the waters of the Jordan. Its historic interest, the marvellous legends which were accepted and passed on by mediæval travellers, its desolate position, and the remarkable character of its water have all helped to make it famous.

In the Bible it is called *The Salt Sea* and *The Sea of the Plain*; whilst among the Greeks and Romans it was known as *Lake Asphaltites*, from the bitumen found floating on its surface. Its more modern name of *Mare Mortuum* or *The Dead Sea* is due to the absence of life in its waters and the scanty vegetation on its shores. Among the Arabs it is still known as *Baheiret Lût* or *The Sea of Lot*.

In shape it is an irregular oblong figure somewhat resembling a bow, the general direction of which is from north to south. On the east and west it is enclosed by ranges of mountains, which in places rise in sheer precipices from the water to a height of over 2,000 feet. Josephus (Bell. Jud. IV., Ch. 8) gave its dimensions as 72 miles long by 18 miles wide, but explorations during the nineteenth century have shown that it is now only 46 miles in length by about 8 miles in width. Some contraction of the area has undoubtedly occurred, but even allowing for this, the earlier estimate must have been too great. The surface of the water is more than 1,300 feet below the level of the sea. The bottom is rocky and uneven, the northern part being very deep, whilst the southern section below the peninsula of Lisan seldom exceeds ten feet in depth.

The lake thus lies in a deep cavity, and being exposed to the burning rays of the sun, evaporation proceeds so rapidly as to more than counterbalance the influx of the Jordan. Incrustations of salts mark the higher levels reached by the water when the river is flooded.

To the south-west lies an extensive range of hills of rock salt, whilst sulphur mines are found on the west coast, and sulphur springs all along the shore. The origin of the asphalt which floats in masses on the water is attributed to the "slime pits" in the vale of Siddim (Gen. XIV., 10). This asphalt is driven by the wind to the western and southern shores, where it is still collected by the Arabs and sold for pitch and for medicinal purposes. According to tradition, it was used by the ancient Egyptians in embalming their dead.

XUM

The site of the cities of the plain has been placed by some in the northern, and by others in the southern part of the lake. Among the legends which were once commonly believed, was that the vestiges of Sodom and Gomorrah could be discerned centuries afterwards. Thus Josephus writes:—"The traces of the five cities are still to be seen, as well as the ashes growing in their fruits, which fruits have a colour as if they were fit to be eaten; but if you pluck them with your hands they dissolve into smoke and ashes."

The marshes adjoining the sea are very unhealthy, and malaria and fever are prevalent among the few tribes which dwell near them. Several explorers have lost their lives from the results of exposure and fever.

The water in mass is bluish-green and resembles sea-water. All accounts from Strabo to the present day agree as to its great density. Pococke, who bathed in it in 1743, found he could lie upon the surface without sinking. This characteristic has been so exaggerated by the earlier travellers that legends have attributed miraculous properties to the water. For instance, Sir John Maundeville in his Travels, published between 1357 and 1371, wrote:—"And neither Man, Beast, nor anything that beareth Life in him may die in that Sea. And that hath been proved many times by Men that have deserved to be dead, that have been cast therein and left there 3 Days or 4, and they might never die therein; for it receiveth no Thing within him that beareth Life. And no man may drink of the water for Bitterness. And if a Man cast Iron thereon it will float above. And if Men cast a Feather therein it will sink to the Bottom, and these be Things against Nature."

The first recorded analysis of the water was made in 1778 by Lavoisier by the then imperfect methods of analysis. He found it to contain 46.6 per cent. of solid matter, consisting of 40 per cent. of calcium and magnesium chlorides, and the remainder of common salt. Analyses have since then been made by Marcet in 1807, by Gay Lussac in 1818, and by T. and W. Herapath in 1850.

A specimen of the water, which I have recently analysed, was brought home some years ago by Mr. Boyle, a descendant of Robert Boyle's brother. It was given to me by his daughter, Mrs. Keely, to whom I take the opportunity of expressing my best thanks.

It was a yellowish dirty-looking liquid with an extremely saline taste. Its specific gravity compared with distilled water at 60° F. was 1.203, a result which agrees well with the figures obtained by Marcet (1.211) and by Lavoisier (1.2403). The variations being satisfactorily accounted for by the different period and distances from the mouth of the Jordan at which the samples were taken.

It is thus one of the densest natural waters known, its specific gravity far exceeding that of sea water, which only averages 1.027.

We may express these figures in other terms by saying that a gallon of distilled water weighs 10 lbs., a gallon of ordinary sea-water $10\frac{1}{4}$ lbs., and the same volume of Dead Sea water 12 lbs.

This accounts for the remarkable buoyant properties of the water, though obviously neither iron nor even aluminium with a specific gravity of only 2.6 would float upon it.

The great density of the water is due to the large quantity of saline matter in solution. The amount found by Lavoisier was doubtless considerably too high, for his analysis was made by the method of crystallization; and the results obtained by other chemists are in better agreement with the 24.46 per cent. which I have found.

The accumulation of salt must be attributed to the ceaseless evaporation of water and continual introduction of fresh supplies charged with salts from the surrounding strata. In sea-water the total salts only average 3.5 per cent.

This excess of saline matter has a very unpleasant effect upon bathers, and, according to Legh, produces a sort of temporary blindness. On leaving the water the skin is rapidly covered with a thin crust of salts.

On igniting the residue left on evaporating the water it darkened, owing to the combustion of the organic matter. This was present in considerable quantity (about 0.5 per cent.), and probably consisted of bituminous substances derived from the asphalt.

The chlorine amounted to 15.9 per cent., and in the residue was chiefly present in combination with magnesium, calcium, and sodium. The chief constituent of the water was thus magnesium chloride, which formed 9.06 per cent. of the total solid matter. In sea-water this salt is present to the extent of about 3.7 parts per thousand.

By combining the amount of sodium (3.35 per cent.) with its equivalent quantity of the chlorine, the amount of common salt in the water was calculated to be 8.52 per cent. It is thus much more than is present in sea-water, where it averages about 2.8 parts per cent. It is interesting to note, however, that whereas in sea-water the amount of ordinary salt is seven times that of the magnesium chloride, in the Dead Sea water they are present in approximately equal proportion. The calcium, which amounted to 1.3 per cent., was probably originally in combination with part of the chlorine, with the exception of a small quantity combined with the sulphuric acid as calcium sulphate or gypsum.

Bromine probably as magnesium bromide composed 0.24 per cent. of the water, and potassium as potassium chloride 1.20 per cent. Small quantities of iron, aluminium, and silica were also identified.

The calculated composition of the solid constituents of the water, excluding the organic matter, was as follows:—

| | Per cent. |
|---|---|
| Magnesium Chloride ... ... | 9.06 |
| Calcium Chloride ... ... ... | 3.49 |
| Sodium Chloride ... ... ... | 8.52 |
| Potassium Chloride ... ... | 2.37 |
| Iron and Aluminium Chlorides ... | 0.55 |
| Calcium Sulphate ... ... ... | 0.148 |
| Ammonium Chloride ... ... | 0.029 |
| Silica ... ... ... ... | 0.083 |
| Magnesium Bromide ... ... | 0.21 |
| Total ... | 24.460 |

## Conducted by M. I. CROSS.

THE MICROSCOPICAL EXAMINATION OF METALS.—It is a little singular that a study which has assumed such great importance as the examination of steel and iron under the

microscope has done during recent years should not have received any treatment whatever in so exhaustive a work as the new edition of "Carpenter on the Microscope." It is a highly technical and important subject, and has become an absolute essential in all iron and steel works. In fact, there is probably no factory of standing that is not equipped with suitable instruments both for observing and photographing.

Although much information regarding the chemical constitution of the metal is disclosed by the microscope, it is in ascertaining the mechanical properties that the special value of the examination lies.

For instance, the structure of steel varies with the different degrees of hardness and the amount of heat to which it has been subjected, and it is possible to gain definite information concerning the suitability of the metal for the purposes for which it is to be used by means of the microscope.

In the manufacture of guns the microscope is invariably resorted to, and it can be definitely determined before the manufacture is proceeded with whether the metal is suitable for the purpose, or any defect has taken place in the heating or quenching which would render the gun unsafe or unsatisfactory.

Engineers can detect flaws, blow-holes, defective welds, etc., and in many ways are able in an early stage to avoid the trouble incident to the use of imperfect metal in the finished article. Microscopes for the exclusive purpose require no substage apparatus or mirror, and although the complete stand is usually employed, the demand has become sufficiently marked for makers to produce special instruments in which a large mechanical stage is provided, but no fittings beneath the stage. Among these are Reichert, of Vienna, C. Baker, of London, and Queen, of Philadelphia. In all of these the vertical illuminator plays an important part; some observers preferring the pattern with a prism, others the cover-glass reflector, while many employ both, finding that each pattern is advantageous according to the structure examined.

When the light and illuminator have once been adjusted, it is important that no movement of the body of the microscope takes place, or the illuminating would have to be re-set. To obviate this, these special microscopes by Queen and Baker have rackwork focussing adjustment to the stage, together with levelling screws, so that any want of parallelism in the piece of metal may be corrected, and the face set at right angles to the plane of the objective. It will be seen from this that the subject has received careful consideration, and that suitable means are available for accurate work.

The metals themselves that are to be observed have to be prepared with great care; the processes are technical, and vary with the purpose of the examination. Generally a small sample block is taken, and cemented to a piece of glass. It is then ground and polished on a series of emery papers, and finally with a very fine polishing material such as rouge, until no scratches can be detected.

Although the harder portions can be in many instances seen at this stage, chemical means have to be resorted to, to differentiate the structure, the action being unequal on the different constituents, and it is by the treatment with such chemicals—nitric acid and liquorice juice being amongst the most important—that the chemical composition is detected. Many of the constituents have received distinctive names, among them being:—

Ferrite, which is the name given to pure iron.
Cementite, representing the iron carbide in steel.
Pearlite, a mixture of cementite and ferrite.
Martensite, the structure of quenched steel.
Austenite, a name given to structure which is produced in steel in which there is a high proportion of carbon.

There is vastly more to be learned of this interesting subject, and it is a field in which the amateur could with interest and profit make investigations.

A very full paper on the matter appears in the *Illustrated Annual of Microscopy of 1900*, by Mr. W. H. Merrett, to which I have referred for several of the foregoing details.

MULTIPLIED IMAGES IN DIATOMS.—Happening to hold a needle over the mirror of the microscope while a slide of Triceratium was under examination, I noticed that its point appeared dimly in each of the interspaces, and on racking the body of the microscope slightly upwards in the same manner as is necessary when observing multiplied images in the cornea of the eye of a beetle, I noticed that it became distinctly sharp. I then placed a piece of black paper cut in the shape of a cross on the mirror, and with a $\frac{1}{8}$ in. objective saw it sharply displayed, although on a much smaller scale than in the eye of beetle.

Experiments were then made with Coscinodiscus and other diatoms, and the same result was shown. This would seem to indicate that these interspaces are lenticular in shape, and it may be that with this knowledge further light may be shed on the complex question of the ultimate structure of some of the Diatomaceæ.

FREE DEMONSTRATIONS IN MICRO. MANIPULATION.—C. BAKER'S 1902 CATALOGUE.—The newly issued edition of C. Baker's catalogue for the present season has been sent to me. The system of classification into separate parts, of microscopes and their immediate accessories, apparatus for collecting, bacteriological and blood examination apparatus, microscope specimens, etc., which made the previous issue of this firm's catalogue so useful for reference purposes, prevails in this new issue.

Apart from the very clear description of the many accessories which are required by the modern student, amateur or laboratory worker, there are one or two features of interest in their list which call for special notice on the part of microscopists generally.

On the first and third Friday and the second and fourth Tuesday in each month, from October to June, between the hours of 3 p.m. and 6 p.m., demonstrations will be given of microscopical manipulation. A syllabus has been prepared, and a series of six demonstrations is arranged to cover practical working with the microscope with modern accessories and by the latest methods.

I am not aware that any such provision has ever been made before, or classes held where such instruction as is now offered by Messrs. C. Baker could be obtained. It is particularly stated that "these demonstrations will be free to all, no charge of any kind whatsoever will be made, and no obligation to purchase is incurred by those availing themselves of this offer."

Another feature is the development of their Slide Lending Department, a system which, I believe, originated with this firm. They have had pamphlets and descriptions prepared to accompany the various slides which are had on loan from them. These have been written by experts in the various subjects, and should be of great value to the private worker.

Catalogues of scientific apparatus nowadays are not so much mere price lists, but invariably contain a large amount of useful information and data, and are always handy for reference purposes.

This new catalogue is one that will be found especially practical, and microscopists should possess themselves of one.

## NOTES AND QUERIES.

*J. B. Morris.*—There is no occasion to use balsam and shellac for fixing your rock sections to a glass plate during grinding. Canada balsam answers perfectly well if only it is used with care. The secret lies in the proper heating of the Canada balsam; if this is carried too far, it easily chips, and if not sufficiently it will not harden quickly. If you make further experiments, you will probably be more successful. There should be no air bubbles between the rock and the glass to which it is fixed; in the event of these appearing the process must be repeated. Balsam and shellac is used by optical glass workers, but as you would only want a very small quantity you could quickly ascertain suitable proportions; very little shellac would be needed.

*W. H. Pearsall.*—The powers and numerical apertures of the Reichert objectives Nos. 3 and 6 are respectively $\frac{3}{5}$″ ·30, and $\frac{1}{6}$″ ·85. These are first-rate lenses. The stand you mention is a very poor one, and you certainly cannot get the full benefit derivable from the objectives with such mechanical means. Swift's four-legged stand is a very good one and is conveniently portable. I do not think you could get greater value for your money from any other maker, and in my opinion this stand possesses many advantages over those made abroad and is

decidedly preferable. If you care to send to the other houses you name for their catalogues, I shall be pleased to give you further advice should you require it, but you will be quite safe with the Swift instrument.

*A. G.*—The best and most comprehensive treatise you can have on the microscope and its general applications, including botanical matters, is the new edition of "Carpenter on the Microscope," edited by Dr. Dallinger, published by Churchill. If you require merely instructions in preparing botanical specimens, you will get this from "Modern Microscopy," published by Ballière, Tindall & Cox.

*E. J. Hunt.*—I have carefully examined the powder you have sent, but could find very few spicules. Sponge tissue, Xanthidia and organic remains generally, are constantly to be found in flint structure. It cannot be regarded as anything exceptional. With regard to the study of Mycetozoa, there is a small work by Sir Edward Fry and Miss Agnes Fry entitled "Mycetozoa, and some Questions which they Suggest," which you might find useful. It is a reprint of articles which appeared in KNOWLEDGE. You will also find the subject treated in a very interesting manner in the new edition of "The Microscope and its Revelations" (Carpenter), edited by Dr. Dallinger; in fact, information on nearly every subject of microscopical study is given in a practical manner in this book.

*Communications and enquiries on Microscopical matters are cordially invited, and should be addressed to* M. I. CROSS, KNOWLEDGE *Office*, 326, *High Holborn, W.C.*

## NOTES ON COMETS AND METEORS.

By W. F. DENNING, F.R.A.S.

THE GREAT COMET OF 1901.—Elements have been published in *Ast. Nach.*, 3734 and 3739, by H. Thiele, of Bamberg, and C. J. Merfield, of Sydney. The figures are nearly identical as follows:—

| T. | | THIELE, 1901, April 24·28845, Mean Time, Berlin. | | | | MERFIELD, 1901, April 24·2526, Mean Time, Greenwich. | | |
|---|---|---|---|---|---|---|---|---|
| | | ° | ′ | ″ | | ° | ′ | ″ |
| ω | ... | 203 | 2 | 15·1 | ... | 203 | 2 | 14·8 |
| Ω | ... | 109 | 38 | 53·1 | ... | 109 | 38 | 37·5 |
| ι | ... | 131 | 4 | 49·3 | ... | 131 | 5 | 40·0 |
| log. $q$ | ... | 9·38827 | | | ... | 9·388907 | | |

There is a possibility that the comet may be seen during the present autumn in some of the large telescopes now available to deal with such faint distant objects. At the beginning of November, 1901, the comet will be nearly stationary in the S.E. region of Cancer, and at a distance of about 300 millions of miles from the earth.

ENCKE'S COMET is now invisible to observers in the northern hemisphere, and, no other known comet being in view, there is really very little to observe in this department. With the exception of the fine object visible in the southern skies in the spring months, there have been no discoveries effected during the present year, and this is rather remarkable when we reflect that the number of comets is very considerable, and that several able observers are engaged in the systematic search for these bodies. Profs. Barnard and Swift (the latter a veteran of 81 years) have, we believe, relinquished comet seeking, but Brooks, Giacobini, Perrine, and others are actively prosecuting the quest, and we may probably, in the ordinary course of events, expect to hear of a discovery very shortly.

FIREBALL OF SEPTEMBER 14, 8H. 44M.—This was an unusually brilliant object, and its descent was witnessed over a large area. The sky was clear and moonless, the hour convenient, and the slow motion and dazzling lustre of the fireball attracted many surprised spectators to watch and record the apparition. In South Wales, and particularly in Pembrokeshire, the object presented a very striking display, and it is described as suddenly lighting up the sky and landscape with startling vividness. At Llandaff the meteor was estimated to be as bright as the full moon, while at Ruabon it was thought to equal the half moon. Even as far distant as Chiddingfold, Surrey, Admiral Maclear described it as intensely bright, while Mr. T. H. Astbury, at Wallingford, Berks, says it appeared much brighter than Venus. The meteor passed over the Bristol Channel, beginning its luminous career when over a point a few miles off Lynton and Ilfracombe, and travelling to north-west it crossed Pembrokeshire, finally disappearing near St. David's Head. It fell from 66 to 26 miles in height along a visible course extending over 83 miles, which it traversed with a velocity of about 20 miles per second. But the various estimates of the duration of flight are, as usual in such cases, very inconsistent. Two of the observers give 2 seconds, while one gives 30 seconds, and another 1 minute! In deriving the velocity it has therefore been found expedient to adopt the mean of a few of what are obviously the best determinations, and these indicate 4 seconds as approximately the duration. A hissing or whirring sound is stated in two cases (St. Clears and Llanwrda) to have accompanied the meteor as it penetrated the atmosphere, while at Little Haven, situated near the terminal point of the flight, Mr. J. Phillips reports a distinctly audible booming sound, which came about three minutes after the nucleus had disappeared. Mr. J. Halton, of Manchester, says the nucleus seemed to plough its way through the atmosphere as though strongly resisted. Mr. Hilditch, of Newport (Mon.), remarks that the object was so luminous and apparently so near that he thought it must have fallen to the earth within a few miles to the north-west of Newport. As a matter of fact, however, the meteor was more than 100 miles distant from this town at the time of its disappearance. Had the object been enabled to withstand disruption during a further interval of about three seconds in which it might have traversed the 56 miles separating it from that point of the earth's surface upon which it was directed, it would have fallen in the St. George's Channel, a few miles off Wexford, on the south-east coast of Ireland.

The meteor left a bright train in its wake, but it quickly died away Several of the observers were at first impressed with the rocket-like appearance of the object and thought it a brilliant firework, but soon after realised the celestial character of the startling visitor.

The radiant point of the meteor was at 345° + 1° near $\beta$ Piscium, and situated between the constellations of Pegasus and Aquarius. There was a brilliant fireball on 1875, September 14, from a radiant at 348° ± 0°, and it appears to have unmistakably belonged to the same system as that which supplied the similar object seen on September 14th last. The shower is a notable one, for its visible activity is prolonged throughout the months of August and September, and it occasionally furnishes fireballs of the largest class.

## THE FACE OF THE SKY FOR NOVEMBER.

By A. FOWLER, F.R.A.S.

THE SUN.—On the 1st the sun rises at 6.56, and sets at 4.32; on the 30th he rises at 7.45, and sets at 3.53. There will be an annular eclipse on the 10th–11th, which, however, is invisible at Greenwich; the central line passes from the Mediterranean across Arabia, Ceylon, and Siam.

THE MOON.—The moon will enter last quarter on the 3rd at 7.24 A.M., will be new on the 11th at 7.34 A.M., will enter first quarter on the 19th at 8.23 A.M., and will be full on the 26th at 1.18 A.M. Some of the occultations visible at Greenwich are as follows:—

| Date. | Name. | Magnitude. | Disappearance. | Angle from North. | Angle from Vertex. | Reappearance. | Angle from North. | Angle from Vertex. | Moon's Age. |
|---|---|---|---|---|---|---|---|---|---|
| | | | | ° | ° | | ° | ° | d. h |
| Nov. 3 | $A^2$ Cancri | 5·8 | 5.32 A.M. | 42 | 47 | 5.59 A.M. | 1 | 0 | 21 17 |
| ,, 4 | ω Leonis | 5·6 | 0.4 A.M. | 41 | 79 | 0.30 A.M. | 348 | 27 | 22 11 |
| ,, 24 | o Arietis | 5·8 | 3.15 P.M. | 29 | 65 | 3.49 P.M. | 300 | 339 | 13 8 |
| ,, 25 | B.A.C. 1240 | 5·7 | 8.11 P.M. | 117 | 155 | 9.0 P.M. | 218 | 252 | 14 13 |
| ,, 27 | 71 Orionis | 5·1 | 10.41 P.M | 12 | 49 | 10.54 P.M. | 350 | 26 | 16 15 |
| ,, 29 | 68 Geminorum | 5·0 | 7.18 A.M. | 142 | 102 | 8.6 A.M. | 251 | 210 | 18 12 |
| ,, 30 | κ Cancri | 5·0 | 9.54 P.M. | 46 | 84 | 10.24 P.M. | 341 | 20 | 19 14 |

THE PLANETS.—Mercury is in inferior conjunction with the sun on the 4th, and will afterwards be a morning star, at greatest westerly elongation of 19° 42′ on the 21st. The times of his rising from the 16th to the 24th, compared with that of the sun, are as follow:—

| Date. | Mercury rises. | Sun rises. | Interval. |
|---|---|---|---|
| | | | H. M. |
| November 16 | 5.27 A.M. | 7.22 A.M. | 1 55 |
| ,, 18 | 5.26 A.M. | 7.25 A.M. | 1 59 |
| ,, 20 | 5.28 A.M. | 7.29 A.M. | 2 1 |
| ,, 22 | 5.32 A.M. | 7.32 A.M. | 2 0 |
| ,, 24 | 5.38 A.M. | 7.35 A.M. | 1 57 |
| ,, 26 | 5.44 A.M. | 7.38 A.M. | 1 54 |

On the 16th the planet will be nearly 8° west of $\alpha$ Libræ, and will pass about 2° north of that star on the 25th. During this time the plant will set about 20° south of west.

Venus is an evening star, setting about 6.22 P.M. on the 1st, and about 7.4 P.M. on the 30th. At the middle of the month about six-tenths of the disc will be illuminated, and the apparent diameter will be 20″·6. The planet will be low down in the south-west after sunset. She will be in conjunction with Jupiter on the 18th, and with Saturn on the 19th.

Mars may be considered not observable.

Jupiter remains an evening star, setting on the 1st about 7.50 P.M., and on the 30th about 6.24 P.M. Under favourable atmospheric conditions the following satellite phenomena may be observed:—

| | | H. M. | | | H. M. |
|---|---|---|---|---|---|
| 2nd.— | II. Sh. I. ... | 5 35 | 10th.— | I. Tr. E. ... | 5 22 |
| | III. Tr. E. ... | 6 8 | | I. Sh. E. ... | 6 24 |
| | II Tr. E. ... | 6 9 | 11th.— | II. Ec. R. ... | 5 49 |
| | I. Ec. R. .. | 7 11 | 13th.— | III. Ec. R. ... | 4 48 |
| | III. Sh. I. ... | 7 23 | 17th.— | I. Tr. I. ... | 5 4 |
| 9th.— | I. Oc. D. ... | 5 47 | | I. Sh. I. ... | 6 1 |
| | II. Tr. I. ... | 6 3 | 18th.— | I. Ec. R. ... | 5 29 |
| | III. Tr. I. ... | 7 13 | 20th.— | III. Oc. R. ... | 5 8 |
| | | | | III. Ec. D. ... | 5 35 |

Saturn is also an evening star, setting on the 1st about 8.7 P.M., and on the 30th about 6.26 P.M. The most notable phenomenon in connection with this planet during the month will be its conjunction with Jupiter on the 28th; this will be the closest conjunction of the two planets which has occurred since 1683, and it will not be until 1961 that there will be another opportunity of observing the two planets in the same low-power field. Mr. Crommelin has calculated the following data for the conjunction:—

| Date (Noon). | Diff. of Long. | Diff. of Latitude Jupiter South. | Distance of Centres. | Elongation from Sun. |
|---|---|---|---|---|
| | ′ | ′ ″ | ′ | ° |
| Nov. 21 ... | 45½ West | 26 33 | 52 | 45 |
| „ 23 ... | 33 „ | 26 31 | 42 | 43 |
| „ 25 ... | 21 „ | 26 30 | 33 | 41 |
| „ 27 ... | 7·6 „ | 26 29 | 27 | 39 |
| „ 29 ... | 5·1½ East | 26 28 | 27 | 37 |
| Dec. 1 ... | 18 „ | 26 27 | 32 | 35 |
| „ 3 ... | 31 „ | 26 26 | 41 | 34 |
| „ 5 ... | 44 „ | 26 25 | 51 | 32 |

Uranus is approaching conjunction with the sun and cannot be observed.

Neptune is well placed throughout the month, rising on the 1st about 7.18 P.M., and on the 30th about 5.22 P.M. The path of the planet is a short westerly one in the western part of Gemini. On the 1st the planet is 3½m. preceding and 17′ south of $\eta$ Geminorum; on the 30th the distances are respectively 6m. and 17′.

THE STARS.—About 9 P.M., at the middle of the month, Gemini will be low in the north-east; Auriga and Perseus high up in the east; Taurus between east and south-east, with Orion below; Aries nearly south-east; Cetus nearly south; Andromeda and Pisces in the south; Cassiopeia almost overhead; Pegasus and Aquarius towards the south-west; Cygnus and Aquila in the west; Lyra a little north of west; Corona setting in the north-west; and Ursa Major below the pole.

Minima of Algol will occur on the 3rd at 9.32 P.M.; on the 6th at 6.21 P.M.; on the 23rd at 11.15 P.M.; on the 26th at 8.4 P.M.; and on the 29th at 4.53 P.M.

# Chess Column.

By C. D. LOCOCK, B.A.

**Communications for this column should be addressed to C. D. LOCOCK, Netherfield, Camberley, and be posted by the 10th of each month.**

## Solutions of October Problems.

### No. 1.

(N. M. Gibbins.)

1. B to Ktsq, and mates next move.

### No. 2.

(B. G. Laws.)

*Key-move.*—1. R to R4.

| | |
|---|---|
| If 1. . . P to B4, | 2. Q to B3ch. |
| 1. . . P to Q4, | 2. Q to B5ch. |
| 1. . . Kt to K4, | 2. Kt to K2ch. |
| 1. . . Kt × P, | 2. Kt × Ktch. |
| 1. . . R moves, | 2. Kt to Q2ch. |

[It is unfortunate that the second solution by 1. . . R × Pch is so obvious. Mr. Laws' problems have been very unlucky in KNOWLEDGE this year.]

CORRECT SOLUTIONS of both problems received from J. Baddeley (6), G. W. (6), G. W. Middleton (6), W. H. S. M. (6), S. G. Luckock (6), W. Nash (6), W. Jay (6), G. Groom (6), A. C. Challenger (6), J. E. Broadbent (6), C. Johnston (6), F. Dennis (6), Vivien Macmeikan (6), H. Le Jeune (5), W. de P. Crousaz (5), Major Nangle (5), C. C. Massey (5), W. H. Boyes (5).

Of No. 1 only from G. A. Forde (Capt.) (2), W. Clugston (2), A. E. Whitehouse (2).

Of No. 2 only from Alpha (3).

*Alpha.*—In No. 1, B to Kt6 is answered by P to K4 only.

*Major Nangle.*—Thanks for the problem, which is, however, too elementary for publication.

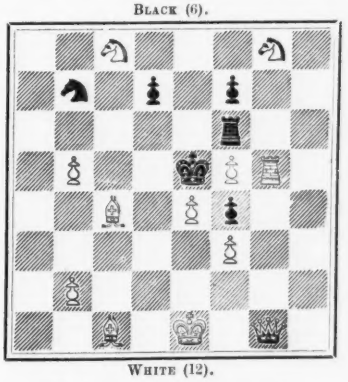
*A. E. Whitehouse.*—Kt to KR5 does not appear likely to solve No. 2. How, for instance, does White proceed if Black plays 1. . . K to Q4?

## PROBLEMS.

### No. 1.

By W. Clugston (Belfast).

BLACK (6).



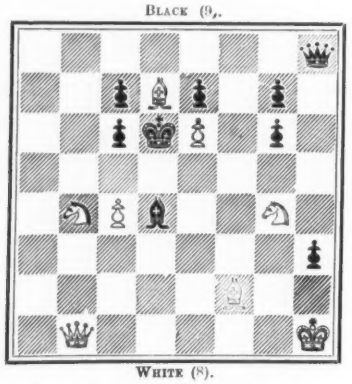
WHITE (12).

White mates in two moves.

No. 2.

By D. L. Anderson.

BLACK (9).



WHITE (8).

White mates in three moves.

The leading scores in the Solution Tourney are now as follows:—

*Fifty-six points.*—A. C. Challenger, W. Jay, C. Johnston.

*Fifty-five points.*—F. Dennis, G. Groom, S. G. Luckock, W. H. S. M., G. W. Middleton.

*Fifty-four points.*—J. Baddeley.

*Fifty-three points.*—G. W.

*Fifty-two points.*—J. E. Broadbent, H. Le Jeune, W. Nash.

*Fifty-one points.*—W. de P. Crousaz, Vivien H. Macmeikan.

*Forty-nine points.*—C. C. Massey.

All these sixteen may be proud of the fact that there are fifty scores below theirs.

The following game was played in the Monte Carlo Tournament:—

"SICILIAN DEFENCE."

| WHITE. G. Marco. | BLACK. J. Mieses. |
|---|---|
| 1. P to K4 | 1. P to QB4 |
| 2. KKt to B3 | 2. P to K3 |
| 3. P to Q4 | 3. P × P |
| 4. Kt × P | 4. QKt to B3 |
| 5. Q Kt to B3 | 5. Kt to B3 |
| 6. KKt to Kt5 (*a*) | 6. B to Kt5 |
| 7. P to QR3 | 7. B × Ktch |
| 8. Kt × B | 8. P to Q4 |
| 9. P × P | 9. P × P |
| 10. QB to B4 | 10. Castles |
| 11. B to Q3 | 11. B to Kt5 (*b*) |
| 12. P to B3 | 12. B to R4 |
| 13. Castles | 13. B to Kt3 (*c*) |
| 14. B × B | 14. RP × B |
| 15. B to Kt5 | 15. Q to Kt3ch |
| 16. K to R1 | 16. Q × P |
| 17. B × Kt | 17. P × B |
| 18. Q to Q2 | 18. Q to Kt3 |
| 19. Kt × P | 19. Q to Q1 |
| 20. QR to Q1 (*d*) | 20. K to Kt2 |
| 21. Q to B4 | 21. Kt to K4 |
| 22. Q to QKt4 (*e*) | 22. R to R1 |
| 23. P to KR3 | 23. Q to QB1 |
| 24. Q to K7 | 24. Q to KB4 |
| 25. K to Kt1 | 25. QR to K1 |
| 26. Q × KtP | 26. R × P (!) |
| 27. P × R (*f*) | 27. Q to Kt4ch |
| 28. K to B2 (*g*) | 28. Kt to Q6ch |
| 29. R × Kt | 29. Q to R5ch |
| Resigns. | |

NOTES.

(*a*) Black has played the old-fashioned form of the defence, but there is nothing to be gained by this attack, even when followed by the comparatively modern 7. P to QR3, instead of the useless check with the Knight. The best move is 6. B to K2.

(*b*) To check with the Rook would probably only induce the Knight to play to K2, on its way to KB5.

(*c*) It would be too risky to win a Pawn at once: *e.g.*, 13. . . Q to Kt3ch; 14. K to Rsq, Q × P; 15. Kt to Kt5, shutting in the Queen.

(*d*) The result of White's combination is that he, instead of his opponent, has now the isolated Pawns, and is, moreover, compelled to make a defensive move. The Black King is perfectly safe.

(*e*) Kt to K3 suggests itself here. White's next move is lamentably weak, and prepares the way for Black's brilliant sacrifice.

(*f*) It is not absolutely necessary to take the Rook. Kt to K3 or P to KB4 might give chances.

(*g*) 20. K to Rsq is compulsory here, in order to avoid any check from the Knight. If then 28. . . Q to Kt6, 29. Kt to B4 (threatening Kt to R5ch), 29. ... Q × Kt, 30. Q to Kt4, Q to B4, and the game is still difficult to save.

## CHESS INTELLIGENCE.

The Albin-Marco match at Carlsbad has resulted in a win for Herr Marco by 4 games to 2, the remaining 4 games being drawn.

Mr. A. F. Mackenzie, the blind composer of Jamaica, has established a record by carrying off the first three prizes in the three-move sui-mate tourney of the *British Chess Magazine*. He has also won the first two prizes in the *Birmingham Post* three-move direct-mate tournament.

It is probable that international tournaments will be held during the coming season at Monte Carlo, Berlin and Hanover. Another interesting event will be a match between the British Chess Club and the Dutch Chess Association.

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